

SB1086

**SACRAMENTO RIVER
CONSERVATION AREA
HANDBOOK**

JANUARY 2002

*Prepared for The Resources Agency
State of California
by the Sacramento River Advisory Council
under the SB 1086 Program*

SACRAMENTO RIVER CONSERVATION AREA HANDBOOK

2002

*Prepared for The Resources Agency
State of California
by the Sacramento River Advisory Council
under Senate Bill 1086
authored by Senator Jim Nielsen*

Revised and updated by the
Sacramento River Conservation Area Forum
June, 2002

*Cover photo: Looking west over Murphy Slough near the M&T flood relief structure. By Geoffrey Fricker
Chapter divider artwork: Toni Cardenas and Narca Moore Craig (Chapter 4)*

Dedicated to Bob Bosworth, who has grown up and worked along the Sacramento River his entire life. Bob is a strong advocate of balancing the needs of agriculture and wildlife habitat for the benefit of future generations.

This Handbook is a “living document.” As conditions change and our understanding of the river system increases, periodic updates may be made. Substantive changes will be made following an established amendment procedure. If you have comments, corrections, or suggestions, please contact:

**Sacramento River Conservation Area Forum
2440 Main Street
Red Bluff, CA 96080
(530) 528-7411**

To view the most current version of the Handbook, please log on our website at: www.sacramentoriver.ca.gov.

Sacramento River Conservation Area Forum

Board of Directors

2001/2002

Ben Carter, Chair

Jane Dolan, Vice Chair—Don Anderson Secretary/Treasurer

Burt Bundy, Manager

Butte County

Jane Dolan, Shirley Lewis

Resources Agency

Mel Dodgin

Colusa County

David Womble, Ben Carter

California Dept of Fish & Game

Diana Jacobs*

Glenn County

Denny Bungarz, Don Anderson

California Dept of Water Resources

Dwight Russell*

Shasta County

Glenn Hawes, Dan Gover

State Reclamation Board

Pete Rabbon*

Sutter County

Dan Silva, Russell Young

US Army Corps of Engineers

Mark Charlton*

Tehama County

Bill Borrer, Brendon Flynn

US Bureau of Reclamation

Laura Allen*

Yolo County

Lynnel Pollock, Marc Faye

US Fish & Wildlife Service

Marie Sullivan*

*Ex-officio

FOREWORD

Passed by the State Legislature in 1986, Senate Bill 1086 called for a management plan for the Sacramento River and its tributaries that would protect, restore, and enhance both fisheries and riparian habitat. The law established an Advisory Council, composed of representatives of state and federal agencies, county supervisors, and representatives of landowner, water contractor, commercial and sport fisheries, and general wildlife and conservation interests.

After more than 50 lengthy meetings and workshops, the Council and its action teams developed a plan which included a specific and action-oriented fisheries plan and a more conceptual riparian habitat plan. This plan, the Upper Sacramento River Fisheries and Riparian Habitat Management Plan (1989 Plan), was published in 1989. Many of the fisheries action items have since been, or are currently being implemented, such as fish bypass structures at diversions on Sacramento River tributaries and the Shasta Dam temperature control structure.

The Riparian Habitat Committee of the Advisory Council, an informal and consensus-based planning group that included landowner representatives, environmental group leaders, and agency personnel, continued the work of on-the-ground implementation. The Advisory Council was reconvened by the Secretary of Resources in 1993 to “complete its earlier work concerning riparian habitat protection and management, including the development of a specific implementation program.”

The committee developed this *Handbook* to guide an implementation program for riparian habitat management along the Sacramento River, and worked to ensure that this *Handbook* addresses both the dynamics of riparian ecosystems as well as the realities of local agricultural issues. It did this by developing a set of guiding principles and planning tools that should govern riparian habitat management along the river.

The six principles fall into the categories of:

- *Ecosystem management
- *Local concerns
- *Flood management
- *Bank protection
- *Voluntary participation
- *Information and education

A Memorandum of Agreement between local, state and federal agencies has been signed by most of the key agencies and all of the named counties that formally adopts the Handbook and commits support for the formation of a locally based nonprofit organization to coordinate activities along the river. In May 2000, the Sacramento River Conservation Area (SRCA), a nonprofit, public benefit corporation was formed. The SRCA is governed by a Board of Directors that includes both private landowner and public interest representatives from each of the seven involved counties, an appointee of the Resources Agency, as well as ex-officio members from six state and federal resource agencies. A Technical Advisory Committee (TAC), composed of experts from relevant disciplines, as well as landowners, has been established to advise the SRCA Board on issues related to river management and site-specific planning. Committee members include agency and academic scientists as well as stakeholders. Much of the work of the organization focuses along an area within the *inner river zone guideline*, where flooding and channel movement are present, primarily between Red Bluff and Colusa. Whether a particular parcel or property is within the inner river zone will be determined on a case-by-case basis, using voluntary participation, erosion and accretion projections, and flood frequency as criteria. If all landowners within the potential inner river zone choose to participate, the area could include about 50,000 acres between Red Bluff and Colusa.

The MOA, Handbook, and Sacramento River Conservation Area represent a new type of sustainable river corridor management in which all stakeholders, including local, state, and federal agencies, public interest groups and landowners are closely involved in the planning and decision making process and implementation of river related activities. Restoration efforts, as well as flood control, water supply and other activities, benefit from the open dialogue fostered through the forum provided by the Sacramento River Conservation Area planning process.

The descriptive and scientific portions of this Handbook (Chapters 2–6) are based upon current knowledge. As our understanding of the Sacramento River system improves over time, these chapters are periodically amended. Similarly, the portions of the Handbook (Chapters 1, 7, 8 and 9) dealing with institutions and policies also become outdated as circumstances change. Therefore, the SRCA Board will, from time to time, adopt revisions to this Handbook. In 2001, the SRCA Board addressed two areas of concern in the Handbook that were not completed prior to the printing of the Handbook, and were listed in the “Issues to be Resolved” section. Through the TAC, and with help from an ad hoc committee that had worked on these issues under the Riparian Habitat Committee, recommendations to formally adopt acceptable language were agreed with and forwarded to the SRCA Board. The Board also worked through the TAC to define the Inner River Zone Guidelines for Reaches 1, 3, & 4, that had not been defined in the January, 2000 edition. Through the Handbook Amendment process outlined in the Appendices, changes were formally adopted as Handbook amendments. Because of the extensive changes in acreages and text, those amendments are incorporated in the 2002 edition of the Handbook.

Recently, the Board amended the Handbook to re-define the outer boundary of the Conservation Area. Below Tehama County, the outer boundary is the same as defined for the Inner River Zone Guidelines. The Board also made it clear that any related activity outside of the IRZ would be addressed by the SRCA. Although not a Handbook change, but noteworthy, was direction from the Board to change its name to the Sacramento River Conservation Area *Forum*. Members of the Board felt that by adding “*Forum*” to the name, it better described the role of the organization.

Foreword

Chapter 1 describes the guiding principles and planning tools that the SRCAF organization uses. Chapter 2 describes the Sacramento River ecosystem and how it relates to riparian habitat. This chapter also includes a complete description of the inner river zone guidelines. Chapters 3 through 6 discuss the river ecosystem in more detail within the four broad river reaches of the Conservation Area. The restoration priorities and inner river zone guidelines are then applied to each reach. Chapter 7 describes existing riparian habitat management programs along the river. Chapter 8 describes those government agencies and private organizations that the nonprofit management entity works with most closely in conducting riparian habitat management activities. Chapter 9 describes the recommended actions to be carried out on the ground. A series of appendices on topics useful to the nonprofit management entity is also included.

The SB1086 Advisory Council - 2002

Denny Bungarz, Glenn County Supervisor, Chair
Bob Bosworth, Past Chair

Dan Silva, Sutter County
vacant, California Water Commission
Bill Borrer, Tehama County
Brendon Flynn, Sacramento Valley Landowners Association
James Fenwood, U. S. Forest Service
Robert D. Clark, Sac River Water Contractors Association
Diana Jacobs, Department of Fish and Game
Mel Dodgin, Commercial fishing representative
Jane Dolan, Butte County
Denny Bungarz, Glenn County
Dwight Russell, Department of Water Resources
Jim Bybee, National Marine Fisheries Service
Gerald Johns, State Water Resources Control Board
David McNamara, Department of Forestry and Fire Protection
Michael Thabault, U. S. Fish and Wildlife Service
Charlie Moss, General Wildlife and Conservation Rep.
Mark Charlton, U.S. Army Corps of Engineers
Pete Rabbon, The Reclamation Board
Steve Shaffer, California Department of Food and Agriculture
Mike Ryan, Bureau of Reclamation
Dwight Sanders, State Lands Commission
Al Wright, Wildlife Conservation Board
Chuck Schultz, Bureau of Land Management
William Waite, Colusa County
Glenn Hawes, Shasta County
Hank Wyman, Natural Resources Conservation Service
Lynnel Pollock, Yolo County

Riparian Habitat Committee 1993-1999

Diana Jacobs, Chair

The Riparian Habitat Committee is an informal group. The following individuals have attended meetings, participated in discussions, and contributed to this handbook:

Ken Anderson, California Department of Fish and Game
Mike Bonner, U.S. Army Corps of Engineers
Bill Borrer, Tehama County Board of Supervisors
Bob Bosworth, SB1086 Advisory Council
Annalena Bronson, California Department of Water Resources
Burt Bundy, Sacramento River Conservation Area Coordinator
John Carlon, Sacramento River Partners
Stacy Cepello, California Department of Water Resources
Bob Clark, Sacramento River Water Contractors Association
Scott Clemons, Wildlife Conservation Board
Kristin Cooper-Carter, University Foundation
Earle Cummings, California Department of Water Resources
Dave Cox, California Department of Parks and Recreation
Julie Cunningham, California Department of Water Resources
Kim Davis, Representing Senator Maurice Johannessen
Matt Davis, U.S. Army Corps of Engineers
Chuck DeJournette, Tehama Fly Fishers
Rich Dixon, California Department of Fish and Game
Rick Dreher, U.S. Army Corps of Engineers
Gary Falxa, U.S. Fish and Wildlife Service
Rebecca Fawver, The Resources Agency
Brendon Flynn, Pacific Farms
Wendell Gilgert, Natural Resources Conservation Service
Tom Griggs, California State University, Chico
Kate Hansel, CALFED-Bay Delta Program
Diane Hanson, U.S. Bureau of Reclamation
Les Heringer, M&T Ranch
Flynn Hoffman, Representing Congressman Vic Fazio
John Icanberry, U.S. Fish and Wildlife Service
Dan Keppen, Northern California Water Association
Patrick Koepele, U.S. Army Corps of Engineers
Joyce Lacey-Rickert, California Department of Water Resources
Jason Larrabee, Larabee Farms
Sam Lawson, The Nature Conservancy
Mike Matthews, EA Engineering
John Merz, Sacramento River Preservation Trust

Marlyce Myers, The Nature Conservancy
Ernie Ohlin, Tehama County
John Repanich, Sacramento Valley Landowners Association/Landowner
representative appointed by the California Department of Food and Agriculture
Pat Repanich, Sacramento Valley Landowners Association
Fraser Sime, California Department of Water Resources
Rita Singer, California Department of Water Resources
John Siperek, California Department of Fish and Game
Jim Snowden, California Department of Fish and Game
Marie Sullivan, U.S. Fish and Wildlife Service
Audrey Tennis
Tanis Toland, U.S. Army Corps of Engineers
Ramon Vega, U.S. Fish and Wildlife Service
William Waite, Colusa County Board of Supervisors
Paul Ward, California Department of Fish and Game

Technical Advisory Committee

2002 Chair-Anjanette Martin

Vice-Chair-Stacy Cepello

The Technical Advisory Committee, composed of scientists from relevant disciplines, has been established to advise the SRCA on issues related to river management and site specific planning. Team members include agency and academic scientists as well as private individuals. Representatives from the following agencies and/or organizations have attended the TAC meetings:

California Department of Fish and Game
U.S. Army Corps of Engineers
Department of Water Resources
Sacramento River Partners
Sacramento River Water Contractors
National Marine Fisheries Service
Wildlife Conservation Board
Department of Parks and Recreation
U.S. Fish and Wildlife Service
State Reclamation Board
CALFED Bay-Delta Program
U.S. Bureau of Reclamation
Bureau of Land Management
Northern California Water Association
The Nature Conservancy
Sacramento River Preservation Trust
Senator Maurice Johannessen
Family Water Alliance
California Farm Bureau Fed.
RD 1001
RD 108
Nor-Cal Guides Association
California Resources Agency

Assemblyman Dick Dickerson
Congressman Doug Ose
Trust for Public Land
Butte County Farm Bureau
UC Cooperative Extension
RD 1500
Colusa County Farm Bureau
Sacramento River Reclamation District
Sacramento Valley Landowners
Association
Hamilton City Community Services Dist
Natural Resources Conservation Service
Assemblyman Sam Aanestad
Princeton-Codora-Glenn Irrigation
District
Butte County
Colusa County
Glenn County
Shasta County
Sutter County
Tehama County
Yolo County
Glenn-Colusa Irrigation District

Acknowledgments

The first edition Handbook, was prepared by the following individuals at the California Department of Water Resources, Northern District, under the direction of the SB1086 Riparian Habitat Committee:

Stacy Cepello
Julie Cunningham
Joyce Lacey

Additional support was provided by the following individuals at the California Department of Water Resources:

Curtis Anderson
Dave Bogener
Koll Buer
Toni Cardenas
Lorry Divine
Mark Dombrowski
Tanya Ehorn
Alison Groom
Eric Haney
Heather Harmon
Ralph Hinton
Matt Kelly
Lori Miles
Tara Morgan
Jared Ramey
Lora Richards
Rodney Sparks
Stan Taylor
and the Graphic Services Branch

The Riparian Habitat Committee thanks the following individuals and organizations for providing information or illustrations for this Handbook:

Steve Arrison, California Department of Fish and Game
George Basye, Downey, Brand, Seymour and Rohwer
John Benoit, Glenn County Resource, Planning and Development Department
Francis Berg, U.S. Bureau of Land Management
Dean Burkett, National Resources Conservation Services
California Native Plant Society
Jim Coates, City of Redding Public Works Department
Val Connor, U.S. Environmental Protection Agency
Sherry Cooper, UC Cooperative Extension
Dave Cox, California Department of Parks and Recreation
Narca Moore Craig

Sally Davis, California Exotic Plant Pest Council
Woody Elliott, California Department of Parks and Recreation
Gary Falxa, U.S. Fish and Wildlife Service
Geoffrey Fricker, Butte College
Molly Fuller, U.S. Forest Service
Tom Griggs, The Nature Conservancy
Todd Hillaire, California Department of Water Resources
Brad Hubbard, U.S. Army Corps of Engineers
Jean Hubbel, California State University, Chico
Dan Keppen, Tehama County Public Works Department
Cathy Klinestecker, Sacramento River Discovery Center
Bill Lawhorn, U.S. Bureau of Land Management
Kent Manuel, City of Redding Planning Department
Eric McGuire, U.S. Bureau of Reclamation
David Morrison, Yolo County Planning Department
Joe Molter, U.S. Bureau of Land Management
Bud Pahl, U.S. Army Corps of Engineers
Daryl Peterson, The Nature Conservancy
Mike Peterson, California Department of Water Resources
Katie Pye, Yolo County Resource Conservation District
George Robson, Tehama County Planning Department
Penny Ruvelas, National Marine Fisheries Service
Ron Schlorff, California Department of Fish and Game
Joe Silveira, U.S. Fish and Wildlife Service
Megan Standard, California Department of Boating and Waterways
Tehama County Public Library
Mike Truden, U.S. Bureau of Land Management
Wayne White, U.S. Fish and Wildlife Service
Dale L. Whitmore, California Department of Fish and Game
Dave Woods, California State University, Chico

2001 and 2002 Revisions

The Sacramento River Conservation Area Board acknowledges the following SRCAF and DWR personnel for their contributions to the 2001 Handbook revisions:

Pat Brown
Burt Bundy
Stacy Cepello
Alison Groom
Kelly Eckels
John Lance
Adam Henderson

Table of Contents

SACRAMENTO RIVER CONSERVATION AREA HANDBOOK TABLE OF CONTENTS

FOREWORD.....	i
MEMBER LIST - SB1086 ADVISORY COUNCIL	iii
MEMBER LIST - RIPARIAN HABITAT COMMITTEE	iv
MEMBER LIST – TECHNICAL ADVISORY COMMITTEE.....	vi
ACKNOWLEDGEMENTS.....	vii
TABLE OF CONTENTS	
LIST OF FIGURES	
LIST OF TABLES	
CHAPTER 1	
BASIC PRINCIPLES AND MANAGEMENT GUIDELINES	
Basic Principles.....	1-2
Management Guidelines.....	1-5
CHAPTER 2	
THE RIPARIAN FORESTS OF THE SACRAMENTO RIVER ECOSYSTEM	
HISTORICAL EXTENT OF RIPARIAN FORESTS	2-2
THE PHYSICAL ENVIRONMENT.....	2-2
Channel Movement and River Meander	2-5
Geology	2-6
Sediment Transport	2-8
Hydrology and Flooding	2-8
THE BIOLOGICAL ENVIRONMENT.....	2-9
The Ecological Adaptations of Riparian Plants.....	2-9
The Changing Mosaic of Successional Stages	2-11
Habitat Types at the Water’s Edge.....	2-19
Riparian Habitat and Wildlife	2-21
Fragmentation of Habitat	2-23
Sensitive Wildlife Species.....	2-24
The Changing Mosaic of Successional Stages	2-11
RIPARIAN FOREST SUCCESSION AND AN INNER RIVER ZONE GUIDELINE.....	2-24

Table of Contents

THE SACRAMENTO RIVER FLOOD CONTROL PROJECT	2-28
The Sacramento River Bank Protection Project.....	2-32
The Sacramento and San Joaquin Rivers Basins Comprehensive Study.....	2-33
CHAPTER 3	
KESWICK DAM - RED BLUFF REACH	
PHYSICAL SETTING	3-2
Geology and Soils	3-2
Historical Channel Movement	3-7
Sediment Transport	3-7
Hydrology and Tributaries	3-7
Land Use	3-8
RIPARIAN VEGETATION.....	3-9
Current Acreage	3-9
Ownership	3-10
Restoration Strategy	3-10
Inner River Zone Guideline.....	3-11
CHAPTER 4	
RED BLUFF - CHICO LANDING REACH	
PHYSICAL SETTING	4-5
Geology and Soils	4-5
Channel Movement	4-6
Sediment Transport	4-7
Hydrology and Tributaries	4-7
Land Use	4-8
RIPARIAN VEGETATION.....	4-10
Current Acreage	4-10
Current Extent of Habitat Types at Water's Edge.....	4-10
Ownership	4-13
Restoration Strategy	4-14
Inner River Zone Guideline.....	4-14
CHAPTER 5	
CHICO LANDING - COLUSA REACH	
PHYSICAL SETTING	5-5
Geology and Soils	5-5
The Sacramento River Flood Control Project	5-5
Channel Movement	5-6
Land Use	5-6
RIPARIAN VEGETATION.....	5-7
Current Acreage	5-7
Current Extent of Habitat Types at Water's Edge.....	5-9
Ownership	5-9
Restoration Strategy	5-10

Table of Contents

Inner River Zone Guidelines	5-10
CHAPTER 6	
COLUSA - VERONA REACH	
PHYSICAL SETTING	6-2
Soils	6-2
Historical Channel Movement	6-5
Flood Control and Reclamation	6-5
Land Use	6-6
RIPARIAN VEGETATION	6-7
Current Acreage	6-7
Ownership	6-8
Restoration Strategy	6-11
Inner River Zone Guidelines	6-11
CHAPTER 7	
CURRENT CONSERVATION AND MANAGEMENT OF RIPARIAN HABITAT ALONG THE SACRAMENTO RIVER	
CONSERVATION PROGRAMS	7-1
CALFED Bay-Delta Program	7-1
Sacramento River Project (The Nature Conservancy)	7-1
The Sacramento River National Wildlife Refuge (U.S. Fish and Wildlife Service)	7-3
The Sacramento River Wildlife Area and Other Properties (California Department of Fish and Game)	7-4
Sacramento River Area (Bureau of Land Management)	7-4
State Parks (California Department of Parks & Recreation)	7-5
Other Holdings (Various Agencies)	7-6
MITIGATION PROGRAMS	7-6
Land and Easements - Sacramento River Bank Protection Project Mitigation (U.S. Army Corps of Engineers and California Department of Water Resources)	7-6
FLOOD MANAGEMENT PROGRAMS	7-7
Murray, Burns and Kienlan Sites (The Reclamation Board)	7-7
Designated and Regulatory Floodways (The Reclamation Board and the National Flood Insurance Program)	7-7
The Sacramento and San Joaquin Rivers Basins Comprehensive Study	7-7
CHAPTER 8	
LOCAL, STATE AND FEDERAL AGENCIES AND PRIVATE ORGANIZATIONS	
LOCAL AGENCIES	8-1
Counties and Cities	8-2
Resource Conservation Districts	8-13
Irrigation Districts	8-16
Levee and Reclamation Districts	8-16

Table of Contents

STATE AGENCIES	8-16
Office of the Secretary for Resources	8-16
California Department of Fish and Game	8-17
Fish and Game Commission	8-20
Wildlife Conservation Board	8-21
Department of Water Resources	8-22
Reclamation Board	8-23
Department of Parks and Recreation	8-24
Department of Boating and Waterways	8-25
California Water Commission	8-25
Office of Emergency Services	8-25
Department of Forestry and Fire Protection	8-26
Regional Water Quality Control Board	8-27
State Lands Commission	8-28
FEDERAL AGENCIES	8-29
United States Fish and Wildlife Service	8-29
United States Bureau of Reclamation	8-30
United States Bureau of Land Management	8-31
United States Geologic Survey	8-33
United States Army Corps of Engineers	8-33
United States Natural Resource Conservation Service	8-35
United States Forest Service	8-35
National Marine Fisheries Service	8-36
United States Environmental Protection Agency	8-37
Federal Emergency Management Agency	8-38
PRIVATE ORGANIZATIONS	8-39
California Central Valley Flood Control Association	8-39
Sacramento River Discovery Center	8-39
Sacramento River Preservation Trust	8-39
Sacramento Valley Landowners Association	8-40
CHAPTER 9	
RECOMMENDED ACTIONS	
Form a Locally-Based Nonprofit Management Organization	9-2
Obtain a Signed Memorandum of Agreement	
Between the Appropriate Agencies	9-2
Develop Site-Specific Plans and Contracts	9-2
Develop Regulatory Consistency/Streamlining Program	9-7
Develop Mutual Assistance Program	9-9
Develop Education and Outreach Program	9-9
Support Monitoring and Research Programs	9-10

Table of Contents

APPENDIX A: Sensitive Plant Species	A-1
APPENDIX B: Wildlife Species	B-1
APPENDIX C: Sacramento River GIS	C-1
APPENDIX D: Acreage Tables	D-1
APPENDIX E: Senate Bill 1086 and Senate Concurrent Resolution No. 62	E-1
APPENDIX F: Report on Costs	F-1
APPENDIX G: Amendment Procedure	G-1
APPENDIX H: Glossary.....	H-1
APPENDIX I (Has been deleted from the Handbook)	
APPENDIX J: Memorandum of Agreement	J-1
REFERENCES	R-1

LIST OF FIGURES

FIGURE	PAGE
1-1 The Structure of the SB1086 Program	1-3
<hr/>	
2-1. The four reaches of the Sacramento River Conservation Area	2-3
2-2. Typical bend on a meandering river.....	2-5
2-3. Sacramento River channel at River Mile 183 in 1896, 1908 and 1991	2-6
2-4. Typical cross-sections of the four reaches.....	2-7
2-5. Typical plant communities and successional stages on the Sacramento River	2-13
2-6. Willow scrub, Sacramento River.....	2-15
2-7. Great valley cottonwood riparian forest, Sacramento River	2-16
2-8. Valley oak woodland near Stony Creek, Sacramento River.....	2-18
2-9. Giant reed (<i>Arundo donax</i>).....	2-19
2-10. Shaded riverine aquatic habitat along the Sacramento River	2-20
2-11. Cut bank with bank swallow burrows, Sacramento River Chico Landing to Red Bluff Reach.....	2-20
2-12. Slough along the Sacramento River	2-21
2-13. The 100-year meanderbelt combined with 50-year erosion projections.....	2-25
2-14. The Sacramento Valley Flood Control System	2-29
<hr/>	
3-1. Sacramento River Conservation Area, Keswick – Red Bluff Reach.....	3-3
3-2. Portions of the Keswick-Red Bluff Reach showing the most channel movement since 1860	3-5
3-3. Narrow corridor of riparian vegetation bordered by native upland vegetation	3-9

List of Figures

3-4. Sacramento River near Bend (RM 257-273) showing area flooded by a 2.5-year recurrence interval flood.....	3-12
---	------

4-1. Sacramento River Conservation Area, Red Bluff to Chico Landing Reach	4-3
4-2. Generalized geologic units and infrastructure (bridges, water diversions, and urban and industrial land uses) along the Sacramento River, RM 214-227 (Vina Quad)	4-5
4-3. Sacramento River corridor near Tehama.....	4-6
4-4a. A comparison of land use patterns between a sinuous subreach and a more stable subreach.....	4-11
4-4b. A comparison of riparian vegetation patterns between a sinuous subreach and a more stable subreach.....	4-11
4-6. Comparison of inner river zone guideline with area inundated in a 2.5 year flood.....	4-18

5-1. Sacramento River Conservation Area, Chico Landing – Colusa Reach	5-3
5-2. Murphy Slough.....	5-8
5-3. Areas inundated at various flood recurrence intervals within the Sacramento River Flood Control Project setback levees	5-11

6-1. Sacramento River Conservation Area, Colusa – Verona Reach.....	6-3
6-2. Narrow “stringer” of riparian vegetation, Colusa – Verona Reach	6-8
6-3. Riparian vegetation near Moon’s Bend (RM 138)	6-9
6-4. Riparian vegetation on waterside berm, downstream of Colusa Bridge.....	6-9
6-5. Area with little riparian vegetation, Colusa – Verona Reach	6-10

9-1 Site – specific management planning.....	9-3
--	-----

TABLE	PAGE
2-1. Common Sacramento River riparian forest species	2-10
2-2. Typical habitats of the Sacramento River system and examples of wildlife utilizing these habitats	2-12
2-3. Exotic plant species within the Sacramento River riparian area	2-18
<hr/>	
3-1. Features of the Keswick-Red Bluff Reach	3-2
3-2. Vegetation and land use, Keswick-Red Bluff Reach	3-8
3-3. Riparian and closely related habitats within the Conservation Area, Keswick-Red Bluff Reach	3-9
3-4. Land ownership, Keswick-Red Bluff Reach	3-10
<hr/>	
4-1. Features of the Red Bluff – Chico Landing Reach.....	4-2
4-2. Geomorphic subreaches of the Sacramento River between Red Bluff and Chico Landing	4-7
4-3. Vegetation and land use, Red Bluff – Chico Landing Reach	4-9
4-5. Riparian and closely related habitats within the 100-year, inner river zone guideline and the Conservation Area boundary, Red Bluff – Chico Landing Reach.....	4-10
4-6. Ownership, Red Bluff – Chico Landing Reach	4-13
4-7. Comparison of areas within the 100-year meanderbelt, inner river zone guideline, area inundated in a 2.5 year flood, and Conservation Area, Red Bluff to Chico Landing Reach	4-17
<hr/>	
5-1. Features of the Chico Landing – Colusa Reach	5-2
5-2. Vegetation and land use, Chico Landing – Colusa Reach.....	5-7
5-3. Riparian and other native vegetation types and closely related classifications within the 100 year meanderbelt and the Conservation Area, Chico Landing to Colusa Reach (land use data).....	5-8

5-4. Ownership, Chico Landing – Colusa Reach.....	5-10
<hr/>	
6-1. Features of the Colusa – Verona Reach	6-2
6-2. Vegetation and land use, Colusa – Verona Reach.....	6-6
6-3. Public and private river access spots, Colusa – Verona Reach	6-7
6-4. Riparian and closely related vegetation within the Conservation Area.....	6-8
6-5. Land ownership, Colusa – Verona Reach	6-10
6-6. Significant areas of native vegetation and potential “natural restoration” areas between levees.....	6-12
<hr/>	
8-1. Local jurisdictions within the Sacramento River Conservation Area.....	8-2

Basic Principles and Management Guidelines

The overall goal of the management program for the Sacramento River Conservation Area (SB 1086) is to *preserve remaining riparian habitat and reestablish a continuous riparian ecosystem along the Sacramento River between Redding and Chico, and reestablish riparian vegetation along the river from Chico to Verona*. This will be accomplished through this incentive-based, voluntary river management plan. Riparian habitat is actually a diverse mosaic of habitat types, which is part of a bigger picture that includes the entire river ecosystem and the humans within it.

Too often, restoration is attempted piecemeal, or is carried out in ways that do not take human activities into account. In the SB1086 program, the principles which provide the foundation for all restoration work are rooted in the fact that riparian habitat is closely linked to the river ecosystem and human activities. These principles, discussed in the next section, fall into six categories:

- Ecosystem management
- Flood management
- Voluntary participation
- Local concerns
- Bank protection
- Information and education

In addition to developing these principles, the committee has also developed a set of management guidelines. These tools are described in this chapter, and discussed in greater detail throughout the Handbook.

- Handbook
- Conservation Area definition
- Inner river zone guidelines and limited meander concept
- Restoration priorities
- Site-specific planning process
- Sacramento River Geographic Information System

The following actions were recommended:

- **Form locally-based, nonprofit management organization**
- **Obtain signed Memorandum of Agreement**
- **Develop site-specific plans and contracts**
 - conservation easements
 - set-aside agreements
 - bank protection
 - acquisition
 - landowner protections
 - floodplain management
- **Develop regulatory consistency/streamlining program**
- **Develop mutual assistance program**
- **Develop education and outreach program**
- **Support monitoring and research programs**

These actions are described in detail in Chapter 9. Figure 1-1 shows the relationship between the goals of the SB1086 program, its guiding principles, and the planning and action items.

Basic Principles:

The guiding principles of the SB1086 Riparian Habitat Management program are as follows:

- **Ecosystem Management** – Management should take an ecosystem approach, providing for the recovery of threatened and endangered species while taking into account human-imposed constraints, using concepts such as a limited meander. Where possible, management should allow for natural re-vegetation in areas of the river's influence. Valley oak woodland, however, needs to be actively re-stored on high terrace lands.

Ecosystem management uses natural processes to create a sustainable system over the long-term, often obtaining the greatest environmental benefits at the least cost. Management decisions should be based on the whole picture—the physical environment, the biological environment, and the human environment. It takes into account the interaction between organisms, their habitat, and physical processes. We must understand how the parts of a large alluvial river system interact before we can sensibly manage its various components. Ecosystem management differs markedly from current regulatory or species centered approaches, where problems are prioritized often without reference to their context.

Another feature of ecosystem management is that working with the physical realities of the system is often cost-effective. By using an ecosystem management approach we *can often gain maximum biological and ecological benefits in the most cost-efficient manner.*

An ecosystem management approach along the Sacramento River recognizes the fact that a large river and its floodplain are inseparable with respect to water, sediment, and productivity. They are so intimately linked that they should be understood, managed, and restored as a single ecosystem. Another key concept is that lateral channel migration is the fundamental process that determines the distribution and extent of riparian vegetation in the Sacramento River system.

GOAL

- Preserve remaining riparian habitat and Reestablish a continuous riparian ecosystem Along the Sacramento River between Redding And Chico, and reestablish riparian vegetation along the river from Chico to Verona

PRINCIPLES

- Use an ecosystem approach that contributes to the recovery of threatened and endangered species and is sustainable by natural processes
- Use the most effective and least environmentally damaging bank protection technique to maintain a limited meander, where appropriate
- Operates within the parameters of local, state and federal flood control and bank protection programs
- Participation by private landowners is voluntary; never mandatory
- Give full consideration to landowner, public, and local government concerns
- Accurate and accessible information/education is essential to sound resource management

ACTIONS

- Form locally-based nonprofit management organization
- Obtain signed Memorandum of Agreement
- Develop site-specific plans and contracts
 - conservation easements
 - set-aside agreements
 - bank protection
 - acquisition
 - landowner protections
 - floodplain management
- Develop permit consistency/streamlining program
- Develop mutual assistance program
- Develop education and outreach program
- Support monitoring and research programs

MANAGEMENT GUIDELINES

- Handbook
- Conservation Area
- Restoration priorities
- Site-specific planning process
- Inner river zone and limited meander concept
- Sacramento River GIS

Chapter 2, “The Riparian Forests of the Sacramento River,” lays the groundwork for ecosystem management by describing the physical and biological components of the system. This chapter also describes the *inner river zone guidelines* (pages 2-24 through 2-28), which are used to determine the most dynamic part of the river ecosystem and where a limited meander might be a useful management tool. The human component of the system is discussed in the section of Chapter 2 pertaining to flood control, as well as throughout chapters 3 through 6 which discuss the four broad reaches of the river between Keswick and Verona.

- **Flood Control** – Conservation Area management must give full consideration to local, state, and federally-sponsored flood control and bank stabilization programs. As a result of the devastating floods of 1997 and 1998, Congress and the State Legislature authorized the State Reclamation Board and the Corps of Engineers “to develop a system-wide, comprehensive flood management plan for the Central Valley to reduce flood damages and integrate ecosystem restoration.” The Sacramento & San Joaquin River Basins Comprehensive Study programmatic document is due in 2002 for final authorization and implementation. Local flood control and bank protection issues must be resolved as part of any site-specific planning. In many cases, the county may maintain federally-constructed bank protection. The state Reclamation Board is responsible for maintaining safe floodways within the Sacramento River watershed. In some areas the Department of Water Resources is charged with maintaining flood control structures built by the federal government. The U.S. Army Corps of Engineers (USACE) constructed the Sacramento River Flood Control Project, the associated Sacramento River Bank Protection Project, and the Chico Landing to Red Bluff Project, a bank protection project. These local, state, and federal agencies should be part of any riparian habitat management planning as applicable. Chapter 7, “Local, State and Federal Agencies and Private Organizations” discusses the duties of those agencies in more detail. The role of the USACE is also discussed at the end of Chapter 2 in the section, “the Sacramento River Flood Control Project.”
- **Voluntary Participation** – Because private landowners own most of the existing riparian habitat on the river, there is a need for incentives, such as conservation easements, set-aside programs, bank protection, and outright purchase to encourage their active participation in riparian habitat management. Private landowner involvement in the programs outlined in this *Handbook* will be strictly voluntary. Chapter 9 describes action items, including many incentive programs, designed to encourage voluntary participation by private landowners in riparian habitat management programs.
- **Local Concerns** – Conservation Area management must give full consideration to landowner, public, and local government concerns. For example, neighboring landowners should not be adversely affected by riparian habitat management decisions on adjacent lands. No county or local government should lose revenue by virtue of an increase in public land. Access to riparian lands should be limited to public areas and managed through education, planning, and arrangements with law enforcement personnel. Neighboring landowners should be invited to be part of any riparian habitat management planning.

The SB 1086 planning process has, by law, included representatives from all of the counties, major interest groups, including landowner and environmental groups, and agencies along the river. This is an essential feature. To ensure that

local concerns are fully addressed, and that true system-wide planning is effective, this must continue.

The issue of local concerns will be addressed in several ways. The proposed nonprofit organization will be locally based, with a board of directors appointed by county supervisors. Site-specific management planning must, by definition, include affected landowners and county representatives. The planning must also address issues such as the effect on the local tax base as well as potential trespassing problems. Mutual assistance programs will be developed to improve cooperation among federal and state agencies and county government.

Another key concern of landowners along the river is changing and inconsistent environmental regulations. The SB1086 program foresees this problem being addressed through permit streamlining, or programs similar to “safe harbors” or “habitat conservation planning,” the development of which would require the active participation of the regulatory agencies. Chapter 9 discusses these action items.

- **Bank Stabilization** – The SB1086 program considers bank stabilization an implementation tool that, when used carefully, can further the goals of the program. Specifically, there are places along the river where bank stabilization will be necessary to limit the meander to the inner river zone. This limitation will take into account the potential need to protect existing land uses including agriculture and structural “hard points” such as buildings, bridges, pumping plants, flood management control structures and levees from bank erosion. A structural “hard point” is defined as a structure or group of structures within the area of recent river meander, that because of various attributes, including but not limited to, historic location, public and private investment, and government commitment, is deemed necessary to be protected from river movement. It is the intent and goal to expedite the permit process for protection of these structural hard points as discussed on pages 9-7 through 9-9. When a need is identified, and other alternatives have been considered, the most effective, economically feasible, and least environmentally damaging techniques should be used. The effect of bank stabilization on natural ecological processes along the Sacramento River is discussed in other areas of the Handbook (sections 2-2, 2-5, 2-33, and 9-6). Decisions on the location of bank protection should be made on a site-specific basis in cooperation with participating landowners. Funding mechanisms for bank protection may vary depending on funding sources and should be written into the site-specific contract.
- **Information and education** - Sound resource management depends upon a solid base of knowledge about the river and the regulations governing its use. A clearinghouse is needed to help riparian landowners obtain grants, permits, and technical assistance for work involving riparian habitat on their property. The need for a clearinghouse of information on the Sacramento River is multi-faceted. Chapter 9 discusses these actions further.

Management Guidelines:

- **Sacramento River Conservation Area** –In 2002, the Sacramento River Conservation Area Board of Directors amended the Handbook to remove the originally designated outer boundary of the Conservation Area except within Shasta and Tehama Counties. The boundary in Shasta and Tehama Counties would continue to be the approximate 100 year designated floodplain. Beginning at the southern Tehama County line, the Inner River Zone Guidelines provide the description for the outer boundary of the Conservation Area. The area, based on soils and floodplain features, denotes the locations where landowners would be eligible to participate in conservation programs. The organization will continue to coordinate with activities outside of the Inner River Zone that relate to the Inner River Zone.

Ownership of property within the Conservation Area will not result in any regulation or taxation to the landowner – it merely makes landowners eligible to participate in voluntary programs. The definition of the Conservation Area for each of the four broad reaches is discussed at the beginning of Chapters 3 through 6.

- ***Inner River Zone Guidelines*** – Much of the work of the SB1086 Riparian Habitat Committee and Advisory Council has centered on the concept of a limited, or managed, meander. A limited meander provides room for the channel movement necessary to attain the goal of the program, but also provides a greater degree of certainty for landowners along the river. A restriction of the Sacramento River's meander patterns may be necessary where studies indicate unobstructed meander, as defined, could impair the operational viability of public and private facilities considered to be protected hard points. The inner river zone guideline has been developed (pages 2-24 through 2-28) to determine that area along the river most prone to channel movement and flooding. It is in these areas that processes are the most intact and, given voluntary landowner participation, should be the first priority for preservation. The actual area, an inner river zone, will be determined on a case-by-case basis using voluntary participation, erosion projections, and flood frequency as criteria. Chapter 2 describes the inner river zone guideline, and Chapters 3 through 6 discuss the guidelines in the context of specific river reaches.

Site-specific Management Planning. The SB1086 program foresees riparian habitat conservation along the river being implemented by both public and private landowners who have developed site specific management plans through a proposed nonprofit organization. Implementation tools that could be incorporated into site-specific management plans might include conservation easements or “set aside” payments, outright purchase, bank protection, technical assistance, and permit streamlining. Chapter 9 contains a detailed discussion of site-specific management planning. When implementing the restoration strategies (as described in Chapters 3-6) and in following the restoration priorities, the proximity of the inner river zone should be the first planning consideration.

--Protect inner river zone boundaries. If the meander is getting close to the inner river zone boundary, decide if bank protection will be installed or if other previously agreed-upon actions will be implemented.

- ***Restoration Priorities*** – Evaluation of restoration projects within the inner river zone must follow the six guiding principles of the program. The site should then be assessed using the following set of restoration priorities. By focusing on river process, these priorities are designed so that projects are carried out in a manner consistent with the guiding principle on ecosystem management. They are listed in order of their significance to ecosystem management of the Sacramento River

and its floodplain. Chapters 3 through 6 contain descriptions of how these priorities apply to each of the four broad subreaches.

--*Protect physical process where still intact.* Does the project protect existing physical process of erosion, deposition, or flooding? Such projects would likely be within *the inner river zone guideline* described in Chapter 2, where erosion and deposition are predicted to occur over the next 50 years and where the river channel has been in the last 100 years. Or, the proposed project might lie in an area outside of the inner river zone guideline, but still be subject to flooding.

--*Allow riparian forests to reach maturity.* Does the project include restoration of process? For example, a project may reduce stress on local flood control systems by redesigning non-strategic flood control structures. Allowing flooding and river channel migration where feasible restores the natural physical and successional process of the river. In some locations, reconnecting the river with its floodplain may increase channel storage (reducing flood effects downstream and regionally), maintain existing riparian forests, and initiate natural self-restoration with a minimum of input.

--*Restore physical and successional process.* Does the project include restoration of process? For example, a project may reduce stress on local flood control systems by redesigning non-strategic flood control structures. Allowing flooding and river channel migration where feasible restores the natural physical and successional process of the river. In some locations, reconnecting the river with its floodplain may increase channel storage (reducing flood effects down-stream and regionally), maintain existing riparian forests, and initiate natural self-restoration with a minimum of input.

--*Conduct reforestation activities.* If the project includes restoration activities, is this used as a last resort? Manual reforestation should be viewed as a last resort for several reasons: it is difficult to determine what vegetation community and structure is appropriate for a given site; it's expensive; it's not always successful.

- ***Sacramento River GIS.*** An important basis of any comprehensive plan for the River is a shared information base, such as that provided by a geographic information system (GIS). The principal advantage of GIS is that digital data are permanently stored and may be accessed quickly for mapping or analysis. The Sacramento River GIS was the primary tool used to define the Conservation Area. This delineation incorporated aspects of geology, geomorphology, soils, hydrology, vegetation, and infrastructure (Appendix C). In a similar fashion, it is presently being used to manage resource information and develop the inner river zone guidelines discussed in Chapter 2.

The GIS is often used to prepare maps illustrating physical factors and river dynamics at specific sites. These maps aid landowners in making sound land management decisions. Although the Sacramento River GIS is useful as an inventory and resource database, it could be developed into a predictive tool to assist in guiding restoration and management decisions. "What if?" modeling of river meandering could be used to evaluate proposed management scenarios and their potential consequences to habitat, wildlife species, and landowners.

Basic Principles and Management Guidelines

The SB1086 program and this Handbook lay a foundation of guiding principles and planning tools with which to achieve its goal of restoring and maintaining a continuous and self-sustaining riparian corridor along the Sacramento River. A nonprofit management entity, supported by organizations and agencies through a Memorandum of Agreement has been formed, and is working to carry out the actions that are essential for the success of the program, uniting site-specific knowledge with a big-picture understanding of riparian habitat issues along the Sacramento River.

The Riparian Forests of the Sacramento River Ecosystem

The Sacramento River Conservation Area includes extends along 222 miles of the main stem between Keswick Dam and Verona (Figure 2-1). The river changes character several times as it travels from the erosion-resistant volcanic tablelands in Shasta County to the broad alluvial basins of Colusa, Sutter, and Yolo Counties.

This chapter provides background on the riparian forest system illustrating the importance of the physical processes of channel movement and flooding in creating and maintaining a diversity of habitat types. These habitat types include the successional stages of the riparian forest, gravel bars and bare cut banks, shady vegetated banks, and sheltered wetlands such as sloughs, side channels, and oxbow lakes. This diversity is key to the wildlife habitat value of the Sacramento River system. By using the restoration priorities discussed in Chapter 1, the physical processes described in this chapter can be used to create and maintain the richness, diversity and continuity of the river's riparian forest ecosystem.

There are four distinct reaches of the Sacramento River between Keswick Dam and Verona, each unique in terms of geomorphology, biology, and human impacts. In the Keswick-Red Bluff Reach much of the river is confined in relatively stable geologic formations and the band of adjacent riparian vegetation is often quite narrow. In the Red Bluff-Chico Landing Reach, it meanders over a broad alluvial floodplain. In both of these reaches a large system of tributary watersheds connects the river with the surrounding uplands.

In the Chico Landing-Colusa Reach the topography changes so that only the Stony Creek tributary provides water to the river. Here, "distributaries" or sloughs once relieved the main channel of excess water during high flows, draining to broad basins which extend for miles on either side of the river channel. Today a series of setback levees and weirs has altered the system of sloughs by controlling the release of flood water into the basins through a system of weirs and bypasses. These setback levees allow the river to continue to meander between them, creating extensive tracts of riparian vegetation.

In the Colusa-Verona Reach most floodwater leaves the main channel through the sloughs and weirs. The main channel itself is tightly leveed, with much of the riparian vegetation existing as linear strips along levees and levee berms.

HISTORICAL EXTENT OF RIPARIAN FORESTS

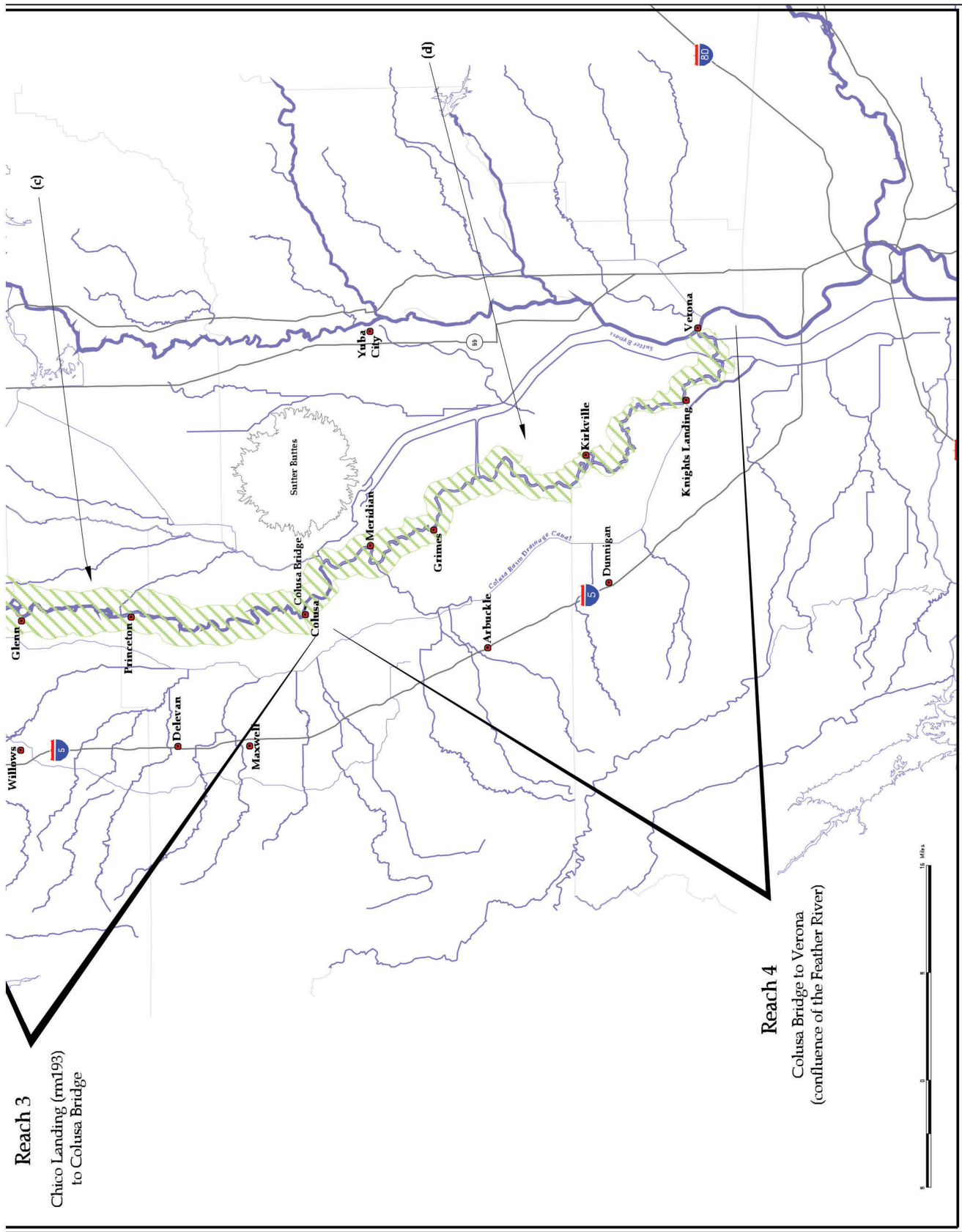
The historical riparian forests and associated valley oak woodland reflected many physical and biological processes. These included cycles of drought and flooding, fire, the erosion and deposition associated with flooding and channel movement, the impact of herds of large herbivores, and the cycle of riparian forest succession. Today, dams and levees have altered the flooding pattern and the impacts of fire and large herbivores have changed greatly. Human land uses have altered much of the floodplain. Nevertheless, along much of the Sacramento River the processes of flooding and channel movement continue to sustain a viable riparian ecosystem.

Historically, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with valley oak woodland covering the higher river terraces (Katibah, 1981). The width of the riparian forest corridor was probably greatest in the Red Bluff-Chico and Chico-Colusa Reaches. Upstream, in the Redding-Red Bluff Reach, the riparian corridor was, as it is today, often confined to a narrow strip along the river's edge. Downstream, along the Colusa-Verona Reach, it is thought that riparian forests, including valley oak woodland, occurred along the natural levees on either side of the river. Beyond the forests lay vast seasonal marshlands in the basin areas. Much of this area became dry alkaline sinks in the summer. In all reaches, the main corridor of riparian habitat was connected to habitat corridors along the river's many tributaries and sloughs.

Rapid development of the Sacramento Valley began in the second half of the 19th century. By 1868 some noticed a scarcity of woody vegetation. Use of trees for lumber and fuel, particularly cordwood for steamboats, reduced the extent of the riparian forests in the Sacramento Valley. Since then urbanization and agricultural conversion have been the primary factors eliminating riparian habitat. Water development projects, including channelization, dam and levee construction, bank protection and stream-flow regulation have altered the riparian system and contributed to vegetation loss (Katibah, 1981). After the construction of Shasta Dam, for example, a decrease in flooding risk contributed to further decline in riparian forests as more lands were converted to orchards (DWR, 1983). There has been some increase in riparian habitat since 1982 (DWR, 1987) (Appendix D). Data compiled in this Handbook indicates that approximately 23,000 acres of riparian habitat and valley oak woodland remain within the Sacramento River corridor, about eleven percent of the original amount.

THE PHYSICAL ENVIRONMENT

Channel movement, geology, and hydrology are physical factors largely responsible for the development and maintenance of riparian forests along the Sacramento River. In many places along the river it is the preservation and restoration of these physical processes that is key to the successful restoration of its forests. This section describes some of the interconnections between these factors and the biology and ecology of the riparian forests along the Sacramento River.



Channel Movement and River Meander

The meandering portions of the river include the Red Bluff-Chico Landing and Chico Landing-Colusa Reaches, and portions of the Keswick-Red Bluff Reach. In meandering river systems, point bars form on the inside (convex side) of channel bends, on alternating sides of the river. Erosion is generally associated with the outside (concave side) of the bends (Figure 2-2). The combination of erosion of outside bends and deposition on point-bars results in channel migration.

Over time, this process of erosion and deposition creates an alluvial floodplain. Channel movement is often incremental and the river bends gradually move downstream. The channel will often move back and forth along a meandering river re-working much of the same area. This area is referred to as a meanderbelt. In areas where the river is actively meandering, it is the translocation, or north-south movement, of these river loops that define the minimum width necessary to maintain the continuum of riparian plant communities created by the river over time. When a meander bend becomes tight, a chute cutoff sometimes occurs, temporarily straightening the channel and creating an oxbow lake (Figure 2-3).

The *sinuosity* of a river channel refers to the tightness of its meander loops. A straight reach has a low sinuosity, while a very curved reach has a high sinuosity.

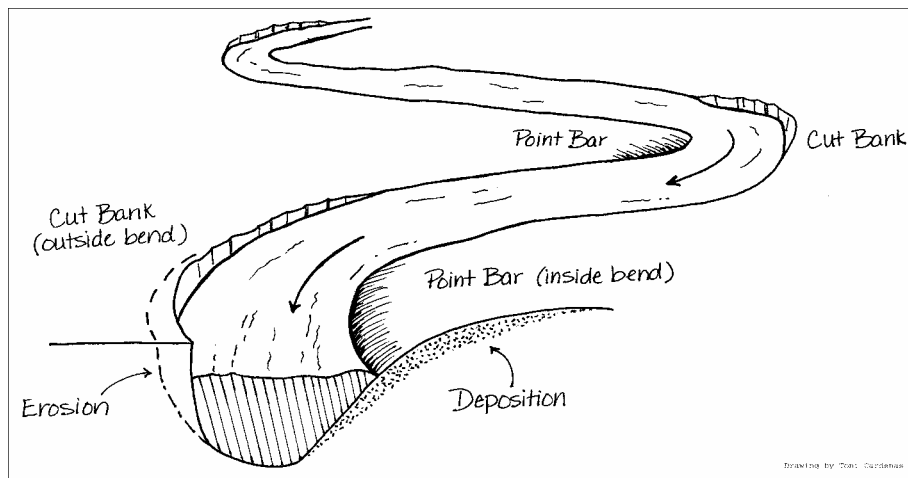


Figure 2-2. Typical bend on a meandering river.

Bank protection is often installed along the outside of river bends to protect existing land uses, including agriculture, as well as buildings, pumping plants, bridges, and levees. These “hard points” may change the rate and pattern of channel movement both up-stream and downstream. When the channel migration process is frozen in place at one bend by bank protection, the bend downstream or across the river may erode more rapidly than it would have otherwise. Bank protection has been most successful where it is placed along geologic control or in long straight reaches parallel to the flow direction.

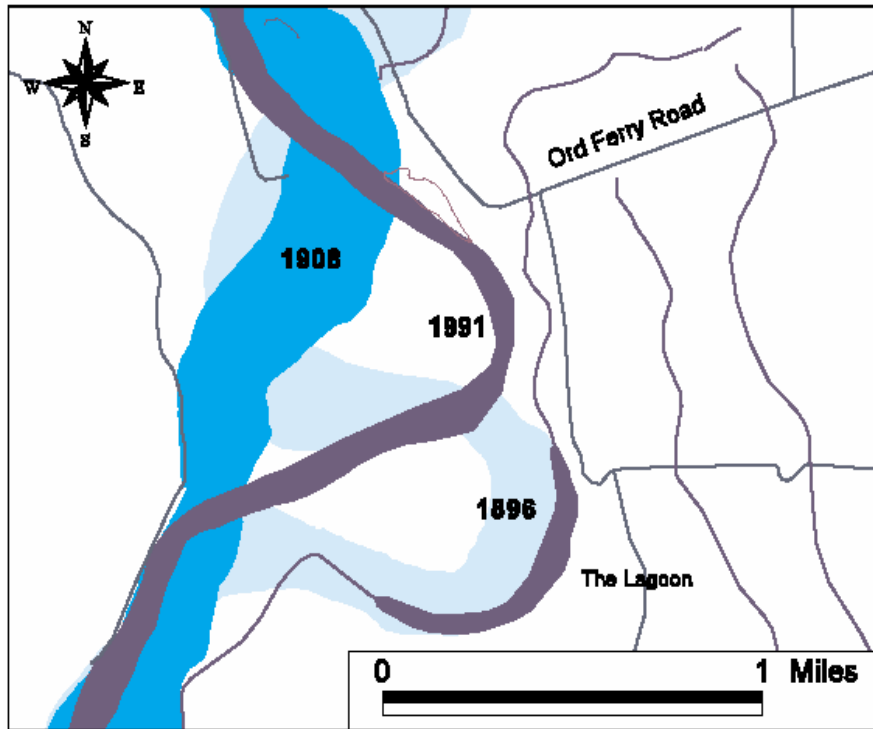


Figure 2-3. Sacramento River channel at River Mile 183, south of Ord Ferry Bridge, in 1896, 1908, and 1991. chute cutoff prior to 1908 resulted in formation of “The Lagoon”, an oxbow lake. Notice development of a new meander bend in the 1991 alignment. NOTE: map indicates channel alignment only. Channel width representation not accurate.

Geology

The geology of the Sacramento River varies considerably among the four reaches. In many areas In the Keswick-Red Bluff Reach resistant formations confine channel movement, resulting in a very narrow riparian corridor. Between Red Bluff and Chico the meander process is occurring in the alluvium along the river and is constrained by older, more consolidated and erosion-resistant geologic formations. These resistant units, the Modesto, Riverbank, Red Bluff and Tehama Formations, are actually older fluvial fans or floodplains, discussed further in Chapter 6. In the Chico Landing-Colusa and Colusa-Verona Reaches basins flank the river, separated from the main channel by natural levees. The very different cross sections of the four reaches reflect the differences in geology (Figure 2-4).

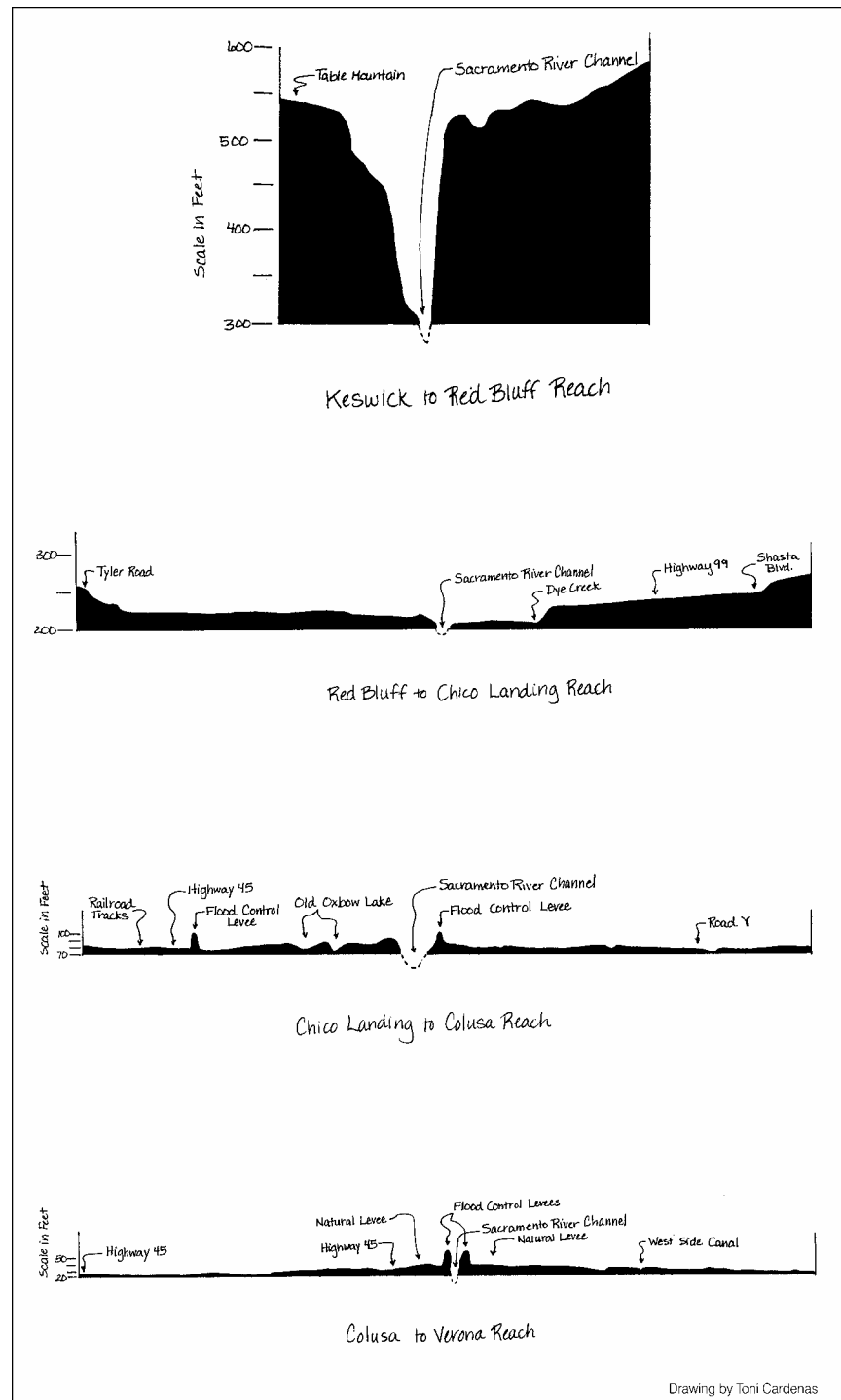


Figure 2-4. Typical cross-sections of the four reaches

Sediment Transport

A river works as a conveyor of sediment, transporting materials eroded from the upper reaches and depositing them in the lower ones. The process of erosion, transportation, and deposition of sediment is closely linked with the pattern of riparian forests on both the historical and present-day landscape.

River channel *stability* refers to the balance between the amount of sediment available and the amount that the river is capable of transporting. When there is more sediment available than the river can carry, the river bed will *aggrade* (bed elevation increases as sediment is deposited). If there is less sediment available than the river is capable of carrying, the river is “starved” and the bed tends to *degrade*.

It is often perceived that because of bank erosion, high-terrace lands are being replaced by low-terrace point bars because Shasta Dam reduces deposition of soils on the flood-plain. Observations made by DWR indicate that this may not be the case.

First, floodplain deposition can still rebuild high-terrace soils at a fairly rapid rate—areas that were river bottom in the 1940s are presently being farmed. Secondly, although the incidence of flood-plain deposition has decreased, so has the rate of bank erosion. A study of land use changes in the Sacramento River riparian zone conducted by the California Department of Water Resources in 1983 similarly concluded that there has been no overall loss of high terrace prime soils since Shasta Dam went into operation, suggesting an overall balance between erosion and deposition. High terrace riparian forest has routinely been converted to agricultural land uses. There is little evidence, however, that depositional imbalance has slowed or hindered riparian forest succession.

Hydrology and Flooding

The magnitude of a flood is described by discharge, commonly measured in cubic feet per second (cfs). The relative size of a flood is often described in terms of a *recurrence* interval. The recurrence interval, the frequency with which such a flood is likely to recur, is based on historical records. The larger the flood, the less frequently it will occur. For example, a “100-year flood” has a recurrence interval of 100 (or Q100). Such a flood has a 1-in-100 chance of occurring in any given year (even if a 100-year flood just occurred the previous year!). A smaller “3-year flood”, on the other hand, has a 3-year recurrence interval (Q3), and a 1-in-3 chance of happening in a given year.

A river is composed of both a channel and a floodplain. When floodwater discharge is greater than the capacity of the channel, portions of the floodplain will become inundated. The “floodplain” is a general term referring to that part of the landscape that shows evidence of sediment deposition from floods of the modern-day river system. It often coincides with the area of reworked alluvium resulting from the meander process. The nature of the floodplain changes considerably along the Sacramento River between Keswick Dam and Colusa. For most of the distance between Keswick and Red Bluff, the floodplain is less than a mile wide, narrowing to less than 500 feet in some places, such as Iron Canyon. Downstream of Red Bluff, the floodplain broadens to between one and one-half to four miles wide south of Chico Landing. The pre-reclamation floodplain actually includes the Butte, Sutter Colusa, and Yolo Basins (Figure 2-1).

The area of the floodplain that is inundated depends on the magnitude of the flood. For example, the area inundated by a 100-year flood on the Red Bluff-Chico Landing Reach of the Sacramento River may be one to four miles wide. On the other hand, a 3-year flood may only inundate an area about 60 ft to 2.5 miles wide.

The Central Valley Project's Shasta Dam has significantly altered the hydrology of the Sacramento River. Water from the upper Sacramento River drainage has been stored in Shasta Lake during the winter and spring months, since September 1943, and released during the summer and fall. As a result, winter flows have lessened and summer flows tend to be higher. The reservoir mostly impounds peak flood-flows, resulting in smaller floods. A large influx of water into the reservoir during a large storm and/or snowmelt occasionally may necessitate high volume releases. These various changes in hydrology may influence the pattern of riparian habitat along the river. Although releases from Shasta Dam highly regulate the hydrology of the Sacramento River, many tributaries still preserve the winter flooding necessary for riparian forest succession.

In addition to the extensive levee and weir system of the Sacramento River Flood Control Project downstream of River Mile 194, there are a number of discontinuous privately-built levees north of Chico Landing. Levees change the pattern of flooding and sediment deposition along the river. For example, a levee may block floodwaters from a portion of the floodplain, preventing the succession necessary for the natural establishment of riparian habitat. Prevention of flooding and deposition at one site along the river, however, can move these impacts farther downstream.

THE BIOLOGICAL ENVIRONMENT

Each plant community is a successional stage that creates an environment that permits the establishment of the next stage until, finally (barring a disturbance), the vegetation becomes a *climax community*. By definition, a climax community will regenerate itself, and continue to exist indefinitely. The establishment of plant communities takes place through the biological process of succession as one plant community replaces another over time. The plant communities in this successional process are known as *seral stages*. Each of these vegetation communities, or seral stages, serves a variety of needs of a different group of wildlife species.

Along the meandering portions of the Sacramento River, succession is tightly linked with the process of deposition on point bars and the gradual accretion of the floodplain. In addition to the various successional stages of the riparian forest, riparian habitat includes shady and bare eroding banks, sloughs, side channels, riparian grasslands, and sand and gravel bars. It also includes the large woody debris and snags in the river itself.

The Ecological Adaptations of Riparian Plants

The plants in the riparian forests of the Sacramento River have many specialized adaptations to life in an environment frequently disturbed by flooding and deposition. The majority of species present along the river are phreatophytes, which must have their roots in contact with a stable water supply. Most of the trees associated with the riparian corridor of the Sacramento River are broadleaved and deciduous during the winter months. Broad leaves enable the tree to maximize the exposure of the leaf sur-

face to light, thus maximizing growth. Such “early colonizing “ species as willows and cottonwood exhibit the rapid growth of foliage and roots necessary for pioneer colonizers to survive the hot, dry summer on a substrate made up of sands or gravels. Table 2-1 lists the most common plant species along the Sacramento River.

Colonizing species are prolific seed producers and most have adaptations for wide-spread distribution. For example, cottonwood seeds are embedded in the cottonlike material floating over wide areas in the spring. Germination will be triggered if the seeds of these species land on a suitable site, such as an open, moist sand bar. The timing of seed dispersal may also be an adaptation to natural hydrologic patterns on the river. For example, cottonwood is adapted to release its seeds in the spring as water levels recede from low terrace riparian areas, providing moist open sites for colonization. Sycamore, which does best on sites with well-aerated soils, releases its seeds in January, just prior to average peak flows, thereby increasing the likelihood of seeds landing on high terrace riparian areas.

Table 2-1. Common Sacramento River riparian forest species.

1. TREES

Scientific Name	Common Name
<i>Acer negundo</i> var. <i>californicum</i>	box elder
* <i>Ailanthus altissima</i>	tree-of-heaven
<i>Alnus rhombifolia</i>	white alder
* <i>Eucalyptus</i> spp.	gum tree
* <i>Ficus carica</i>	edible fig
<i>Fraxinus latifolia</i>	Oregon ash
** <i>Juglans californica</i> var. <i>hindsii</i>	Northern California black walnut
* <i>Maclura pomifera</i>	Osage-orange
<i>Plantanus racemosa</i>	California sycamore
<i>Populus fremontii</i>	Fremont cottonwood
<i>Quercus lobata</i>	valley oak
<i>Quercus wislizenii</i>	interior live oak
* <i>Robinia pseudoacacia</i>	black locust
<i>Salix goodingii</i>	black willow
<i>Salix laevigata</i>	red willow
<i>Salix lucida</i> ssp. <i>Lasiandra</i>	yellow willow

2. SHRUBS

Scientific Name	Common Name
<i>Artemisia douglasiana</i>	mugwort
* <i>Arundo donax</i>	giant reed
<i>Baccharis douglasii</i>	marsh baccharis
<i>Baccharis pilularis</i>	coyote-brush
<i>Baccharis salicifolia</i>	mule’s fat
<i>Calycanthus occidentalis</i>	spice bush
<i>Cephalanthus occidentalis</i> var. <i>californicus</i>	California button-willow
<i>Heteromeles arbutifolia</i>	toyon
<i>Hibiscus lasiocarpus</i>	rose-mallow
<i>Rhamnus tomentella</i> ssp. <i>Tomentella</i>	hoary coffeeberry
<i>Rosa californica</i>	California rose
* <i>Rubus discolor</i>	Himalayan blackberry
<i>alix exigua</i>	sandbar willow
<i>Rubus ursinus</i>	California blackberry

<i>Salix lasiolepis</i>	arroyo willow
<i>Salix melanopsis</i>	dusky willow
<i>Sambucus mexicana</i>	blue elderberry
* <i>Tamarix parviflora</i>	tamarisk

3. COMMON VINES, PERENNIAL GRASSES AND SEDGES (UNDERSTORY SPECIES)

Scientific Name	Common Name
<i>Aristolochia californica</i>	California pipevine
<i>Carex barbarae</i>	Santa Barbara sedge
<i>Clematis ligusticifolia</i>	virgins-bower
<i>Leymus triticoides</i>	alkali ryegrass
<i>Smilax californica</i>	California greenbrier
<i>Toxicodendron diversilobum</i>	poison oak
<i>Vitis californica</i>	California wild grape

* Exotic species

**Native (versus introduced) status is currently a matter of dispute (Griffin, 1972).

Other adaptations which some riparian species exhibit include:

- seeds which float and are resistant to rotting;
- adventitious roots (roots from the buds along the buried stem) which form after sand and silt is deposited over the plants during flood events;
- ability to tolerate low levels of oxygen in the soil during flooding events; and
- ability to form suckers and roots after mechanical damage.

These mechanisms ensure survival in the river zone which is seasonally inundated. This all but guarantees that the initial colonizers will not be able to replace themselves at the site; instead they will colonize another newly disturbed area and the cycle will repeat.

As silt accumulates under the willow-cottonwood scrub, other trees such as box elder and ash are able to germinate in the spring after flood flows have stopped. Because the existing trees have slowed flood flows the depositional materials in these areas tend to have a higher percentage of fine material such as silt; finer soils are able to retain moisture longer than sandy and gravelly substrates. Species such as box elder and ash can tolerate some deposition, but not to the extent of the early colonizers. Plants found in the most mature riparian forest of the river, the valley oak riparian forest, are unable to survive within areas which have heavy silt deposition.

Other riparian species found in more mature stands are not adapted for frequent flooding; their seeds tend to be heavier and, because of a susceptibility to molding, require a drier site for establishment. These species tend to be shade tolerant and are able to develop under the closed canopy of earlier successional stages.

The Changing Mosaic of Successional Stages

When viewed from the surrounding foothills, the riparian forests of the Sacramento River may appear as a uniform blanket of lush green growth. A closer view, however, reveals distinct bands of vegetation, differentiated by plant species composition, forest structure and wildlife usage. The Sacramento River system is actually composed of a wide variety of habitat types (Table 2-2).

Along the Sacramento River the process of succession is most pronounced in the meandering reaches (Red Bluff–Chico Landing, Chico Landing–Colusa, and parts of the Keswick–Red Bluff Reaches). It also occurs elsewhere, but may be difficult to see because of the narrowness of the riparian corridor, the frequency of disturbance from flooding, or an altered substrate such as rock revetment.

The successional stages of the riparian forests along the Sacramento River can be classified into four plant communities (a fifth habitat type, valley oak woodland occurs above the high frequency floodzone), although any one species of tree, shrub, or vine could occur in more than one plant community. In other words, there is an intergrading between communities and rarely is there an abrupt edge between them. Figure 2-5 shows the typical succession pattern for these communities in relation to river hydrology and channel movement. Such other plant communities as valley oak woodland, wetland, and nonnative grassland often occur in conjunction with riparian forests. This *Handbook* uses the plant community classification of Robert Holland (1986).

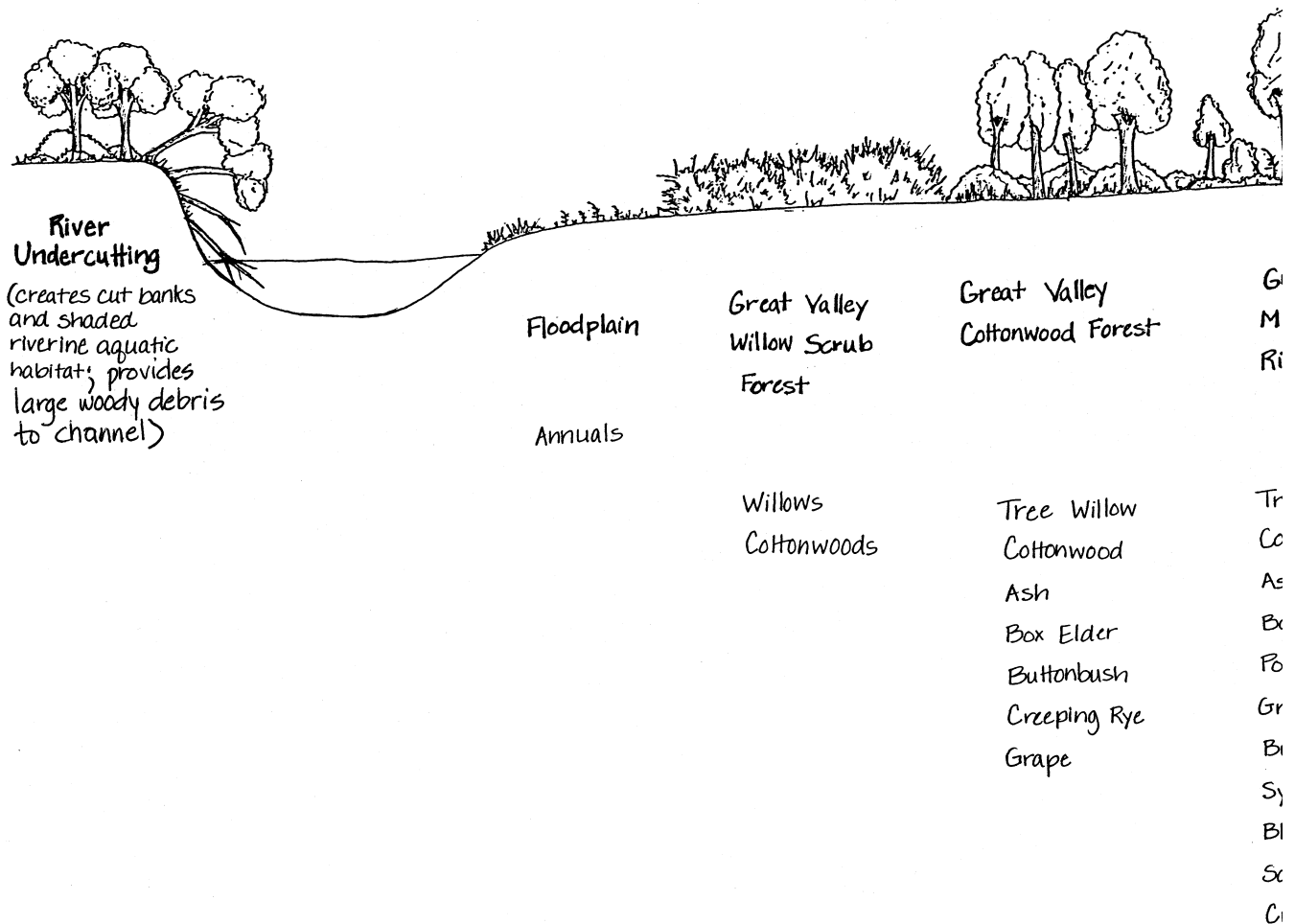
Table 2-2. *Typical habitats of the Sacramento River system and examples of wildlife using these habitats.*

HABITAT TYPE	EXAMPLES OF WILDLIFE USE
Gravel Bars	Nesting killdeer, spotted sandpiper and lesser nighthawks; foraging water birds
Cut Banks	nesting bank swallows
Heavily Shaded Banks (SRA)	juvenile salmon burrowing otter and beaver
Willow Scrub	nesting blue grosbeaks
Wetlands	foraging water birds
Sloughs and Side Channels	egret and heron rookeries basking western pond turtles
Great Valley Cottonwood	foraging yellow-billed cuckoos and Cottonwood-Oak Riparian Forests nesting eagles, osprey, Swainson's hawks
Open Grassland	foraging Swainson's hawks
Valley Oak Woodland	nesting owls, woodpeckers and bluebirds

Great Valley Willow Scrub

This is the pioneer riparian community found on depositional areas (point bars) near the river's edge. The community will tend to survive along a band that meets the substrate, texture, and moisture requirements of the germinating seeds (Figure 2-6). The young plants prefer a coarse substrate such as sands and gravels. The rapidly growing root systems must reach the ground-water before it recedes to summer levels. If conditions allow, the narrow bands of young cottonwoods in this community will become the riparian forests of the future. (Figure 2-5). The most common willow species identified with this community is sandbar willow, easily identified by its dense gray-green foliage. Also commonly occurring within the

Figure 2-5. Typical Plant Communities and Successional Stages



Elevation relative to river; time between n

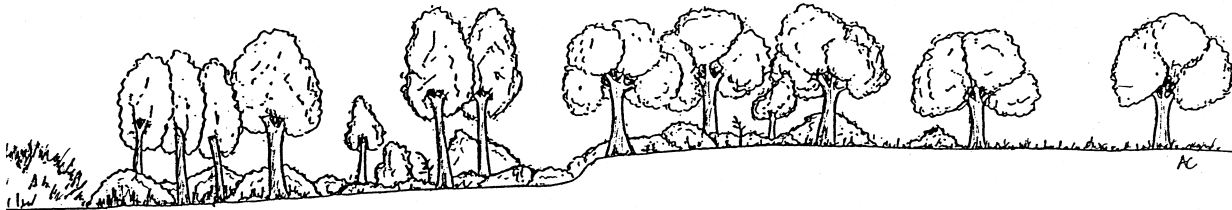
Lo —————

Hi ← —————

Frequency, duration, and depth of

* Adapted from Conrad, 1977

and Successional Stages on the Sacramento River



Great Valley
Cottonwood Forest

Great Valley
Mixed Riparian
Riparian Forest

Great Valley
Valley Oak
Riparian Forest

Valley Oak
Woodland

Tree Willow
Cottonwood
Ash
Box Elder
Buttonbush
Creeping Rye
Grape

Tree Willow
Cottonwood
Ash
Box Elder
Poison Oak
Grape
Buttonbush
Sycamore
Black Walnut
Santa Barbara Sedge
Creeping Rye

Valley Oak
Ash
Black Walnut
Sycamore
Pipevine
Grape
Calif. Rose
Poison Oak
Creeping Rye
Santa Barbara Sedge

Valley Oak
annual grasses

relative to river; time between major disturbances

→ Hi

→ Lo

frequency, duration, and depth of inundation

Drawing by Toni Cardenas

Figure 2-5. Typical plant communities and successional stages on the Sacramento River



Figure 2-6 *Willow scrub, Sacramento River*

stands are other willows (black, red, yellow, arroyo and dusky willows) as well as young cottonwoods. Young sycamores, box elders, walnuts and Oregon ash may become established as the ground becomes shaded by willows and cottonwoods but, because of the high frequency of flooding, they may be washed out or buried under deposited material.

Openings within willow scrub may be covered by annual and perennial grasses and forbs. As deposition of soil continues (and the river meanders away from the point bar), the length and frequency of flooding decreases and the community develops into a great valley cottonwood riparian forest.

Young, lush cottonwood-willow stands tend to support high concentrations of invertebrates, which provide food for migratory and resident insectivorous bird species. Species such as blue grosbeak also use low dense willow and cottonwood thickets for nest sites.

Great Valley Cottonwood Riparian Forest

As its name indicates, this community is dominated by cottonwoods (sometimes 100 percent of the upper canopy) which have established dominance over the early colonizing willow species (Figure 2-7). A second tall tree, *Salix goodingii* (black willow), is often a significant member of this community. Additionally, many species are able to germinate under the dense canopy cover, including berries, wild grape, poison oak, and many tree species which can develop into a dense understory. All of these tree species require a permanent subsurface water supply.

Yellow-billed cuckoos and other medium to small-bodied land birds are often associated with this plant community during the spring and summer.

Trees such as box elder and ash may become established in the understory, but do not become significant canopy species until flooding becomes less frequent. When this occurs, the community succeeds to a mixed riparian forest.



Figure 2-7. *Great Valley cottonwood riparian forest, Sacramento River*

Great Valley Mixed Riparian Forest

This community has a diverse, often dense mixture of tall mature cottonwood and willows, as well as sycamores, box elders, walnuts and alder. Shrubs such as buttonbush, blackberries, and poison oak are often covered by an assortment of vines (clematis, wild grape, and pipevine) which extend up into the overstory trees. Perennial grasses such as creeping rye and the Santa Barbara sedge may form dense pockets in the understory. Openings within this community may also contain elderberry savannas. This community also supports nesting yellow-billed cuckoos and other medium–small-bodied land birds.

The great valley mixed riparian forest may be a fair distance from the active channel but still experience overbank flooding. This brings additional deposition but not necessarily damaging flows and subsequent erosion. As the community becomes “drier”, (i.e. further above the water table), species such as valley oaks are able to germinate and become established. Over an extensive period of time this species becomes dominant and the community develops into the most mature of the four riparian vegetation types.

Great Valley Oak Riparian Forest

This spectacular plant community was once extensive along the Sacramento River. Valley oaks dominate the closed canopy riparian forest with significant numbers of black walnuts, sycamore, and ash. The understory may be dense with various vines, typical shrub species (and species from drier sites), and very often with stands of perennial grasses and sedges. Also present within this community type between Red Bluff and Colusa are very large, often very old specimens of elderberry.

These areas are still subject to flooding where the hydrologic regime is intact. Good regeneration of valley oak often occurs at sites with little livestock grazing or active agriculture. As a site becomes flooded less frequently and rises further above the water table, it may develop into valley oak woodland or annual grassland.

Valley Oak Woodland

Some consider valley oak woodland to be the climax community for the riparian habitats (Figure 2-8). It occurs on the deep alluvial soils of the higher floodplain terraces but can also be found in other upland communities (Griffin, 1972). A canopy covering of up to 40 percent valley oaks is typical; non-native grasses dominate the understory. This plant community once covered extensive areas of alluvial soils, forming wide bands alongside the riparian forest. Today, isolated islands of majestic, old valley oaks occur in alluvial soils on the river's historical floodplain. Valley oak woodland occurs in association with river systems, but its regeneration does not depend on flooding and deposition, and will become established in areas of rich, loamy soils with good drainage. In suitable years, in areas with little livestock grazing or active agriculture, the valley oak is often capable of reproducing.

Other Plant Communities

Pockets of different plant communities may occur within or adjacent to the riparian corridor. These include upland communities such as non-native annual grassland, valley wildrye (*Leymus triticoides*) grassland and elderberry savanna. Additional communities are associated with areas of standing water either perched alongside the channel, as occurs in the volcanic formations between Red Bluff and Redding, or associated with cut-off meanders such as Murphy Slough. In these areas, typical marsh plants provide a very different habitat type; areas of calm waters support animal species such as western pond turtles and various wading birds and waterbirds. Vegetation consists of typical emergent species (tules and cat-tails) or floating mats of water primrose. Bordering these wetland areas are areas of buttonbush scrub. An unusual ephemeral freshwater marsh type is upstream of the Bend Bridge. Several pools that occur on the volcanic formations were found to support typical Vernal pool flora, despite having high water flows over them during the winter months.

Exotic Species

Plant species which have become established within natural ecosystems but were not native to California prior to European settlement are often referred to as "exotics". The reasons for importing these species into California include erosion control, food crops and animal fodder, use in gardens, as well as accidental introduction. Table 2-3 lists the exotic plant species found within the Sacramento River system.

Some of these species are extremely invasive and have been able to displace native plant species. Adaptations of "successful" invading species include the production of large amounts of seeds, fast growth, and the ability to reproduce from small pieces of plant. Adding to these advantages is frequently the lack of natural predators, diseases or competing plants. A plant species with these adaptations can quickly take over a natural ecosystem, and in doing so, may eliminate valuable wildlife habitat. An example of such a species is *Arundo donax* (giant reed), a large bamboo like plant along the Sacramento River (Bell, 1993) (Table 2-3, Figure 2-9). Giant reed is able to reroot from small pieces of plant. It tolerates a wide variety of soil types but becomes established primarily in alluvial deposits which, in the Sacramento Valley, often support willow scrub plant communities. It grows at an alarming rate (3-1/2" per day under optimal conditions) and any attempts to remove the plants mechanically simply sends additional pieces downstream to start new colonies. Because of this rapid growth, the ground is quickly covered and species



Figure 2-8. Valley oak woodland, Sacramento River

such as cottonwoods and willows are unable to become established. A population of the reed at the top of a small tributary can result in numerous colonies downstream. When dry, giant reed burns easily and will sprout readily after a fire. Fire in a stand of giant reed may over time eliminate any remaining riparian species. Little wildlife value exists in giant reed colonies.

Other exotic species, such as tree of heaven, which appear to “fit” into the riparian habitat, are also poor wildlife habitat, either because of a lack of cover value or structure, or because the seeds produced are of low nutritional value. Some plant species have the ability to produce chemicals which inhibit the germination of competing plant species. The edible fig (*Ficus carica*), an exotic species common on the higher riparian terraces, has this ability.

Table 2-3. Exotic plant species within the Sacramento River riparian area.

<i>Arundo donax</i>	Giant reed
<i>Rubus discolor</i>	Himalayan blackberry
<i>Tamarix chinensis</i>	salt cedar
<i>Eucalyptus globules</i>	tasmanian blue gum
<i>Ailanthus altissima</i>	tree of heaven
<i>Ficus carica</i>	edible fig
<i>Robinia pseudoacacia</i>	black locust

Sensitive Plant Species

Many plant communities associated with the Sacramento River have declined in acreage and are considered rare enough to be included in the CNDDDB computerized inventory of the State’s sensitive biota (DFG, 1996). Appendix A includes a list of sensitive plant species known to occur within or near the Conservation Area, a brief description of their habitats, and their current legal status.

Of the 16 species, only the rose mallow (California hibiscus) and the silky cryptantha are known to occur within the Conservation Area. Several populations of the rose mallow occur in marshy areas such as backwaters within oxbows between



Figure 2-9. Giant reed (*Arundo donax*)

Knight's Landing and Golden State Island. The silky cryptantha has been found near tributaries within the northern reaches. Populations are known from Battle, Cottonwood and Frazier Creeks near the Sacramento River.

The remaining species, except the adobe lily, are associated with ephemeral swales, pools, and alkaline areas. Adobe lilies are found on deep heavy clays and are unlikely to be found within the riparian habitat.

Habitat Types at the Water's Edge

In addition to creating a mosaic of riparian forest plant communities, the river system creates many other critical habitats and habitat elements. Erosion, channel movement flooding and aggradation create sloughs and side channels, sand and gravel bars, bare cut banks, and shady banks with vegetation and woody debris extending into the water. These forces also contribute (through channel change and aggradation) to the aging of cottonwoods into dead snags, an important habitat element. All of these features play an integral part in the functioning of the riparian ecosystem. Habitats are used by different species for different needs, such as foraging or nesting. Table 2-2 illustrates the importance of these habitats and habitat elements to various wildlife species along the Sacramento River.

Shaded Riverine Aquatic Habitat

Shaded banks are an important component of the Sacramento River ecosystem, created as the river erodes into a bank supporting riparian forests (Figure 2-10). This habitat has an important aquatic component. The U.S. Fish and Wildlife Service has dubbed this type of area "shaded riverine aquatic cover," (known as SRA) an area where "the adjacent bank is composed of natural, eroding substrates supporting riparian vegetation that overhangs or protrudes into the water" (USFWS, 1992). It is also characterized by "variable amounts of woody debris, such as leaves, logs, branches and roots, as well as variable depths, velocities and currents." SRA provides feeding and cover for aquatic species such as salmon, and when less vegetated (see following section on cut banks) provides burrowing substrate for bank swallows.



Figure 2-10. *Shaded Riverine Aquatic Habitat along the Sacramento River.*

Cut Banks

Cut banks are another important component of the riparian ecosystem along the Sacramento River. Most often associated with valley oak woodland and high terrace agriculture, cut banks along the Sacramento River also support the majority of California's bank swallow (*Riparia riparia*) colonies. The migratory bank swallow, which winters in Central and South America, nests in the spring, mostly in steep freshly eroded earth banks (Figure 2-11) bank swallow habitat between Chico Landing and Red Bluff.

Sloughs and Side Channels

Channel movement creates sloughs and side channels which contribute to the richness of the riparian ecosystem (Figure 2-12). Sloughs provide shelter from the fast current of the main channel creating habitat for many wildlife species such as beavers and pond turtles. Sloughs and side channels often have shaded riverine aquatic habitat along their banks. Most heron rookeries are located in sloughs or oxbow lakes.



Figure 2-11. *Cut bank with bank swallow burrows, Sacramento River, Chico Landing-Red Bluff Reach*



Figure 2-12. *Slough along the Sacramento River*

Such areas, particularly when surrounded by riparian forests, also offer refuge from human disturbance. The interface between the waters of the river and adjacent land surface is very important for foraging wildlife species. Side channels, sloughs, and oxbows greatly increase the length and amount of this interface. For example, between River Mile 235 and 239 (the vicinity of Todd Island in Tehama County), the length of the water-land interface along the main channel is increased by over 200 percent due to the presence of side channels, sloughs and oxbow lakes.

Riparian Habitat and Wildlife

Anyone walking from a grassland or open field into a riparian area along the Sacramento River during a hot summer day is acutely aware of the abrupt change in habitat. Not only is the area cooler because of a dense closed canopy but the air is humid due to high transpiration rates of the surrounding trees. Grass and annual species which dried up weeks or months ago in the adjacent lands, remain green and succulent under the numerous layers of riparian vegetation.

Cottonwood-willow riparian areas support more breeding avian species than any other comparable broad California habitat type (Gaines, 1977). Riparian forests along the Sacramento River have several characteristics which enable them to support such an abundance and diversity of wildlife. *Abundant resources, high structural and habitat diversity*, (maintained over time by flooding and channel movement) and *linear continuity* all contribute to the diversity of wildlife species in riparian habitats (Warner, 1979).

Proximity to water, rich deep soils, and the periodic influx of nutrient-rich sediment from flooding contribute to the abundance of resources in the riparian forest system. This abundance continues throughout the summer and autumn months, in contrast to much of California, which lies dry and dormant. It attracts caterpillars, moths, butterflies and aquatic insects which in turn attract many species of birds and fish.

The riparian forest system also has a *diversity of habitat types and high structural diversity*, both providing a variety of roosting, nesting and foraging opportunities for a wide range of wildlife species. The many plant communities and habitats described earlier contribute to the diversity of habitat types. In addition, there is high structural diversity within the forest itself. Trees with a range of sizes and ages, a diverse understory, thick ground cover (which may include debris brought in by flood waters) and, in mature stands, tall dead snags all contribute.

The dynamic nature of the river system is key to this diversity. As the course of the river changes and as riparian plant communities mature, both the species and the composition of plant and wildlife communities change. For example, an area of willow–cottonwood scrub containing young seedlings and sapling trees may be an ideal site for nesting willow flycatchers. Several decades later, deposition may have raised the site further from the water table. The willows may have died and the cottonwoods matured. Snags will offer nesting habitat for osprey.

Another example is a heavily vegetated bank providing cover for river otter or instream cover for migrating salmon. As the river changes course erosion may remove this vegetation and cover, but the site then may become ideal for nesting bank swallows.

Despite the unending change in habitat at any particular site on the river, under ideal conditions, the relative proportion of habitat types will remain constant over the years. As willow scrub matures to a mixed riparian forest, for example, bare gravel bars will begin to support willow scrub. As a heavily shaded bank is exposed by erosion, changes in channel alignment will result in another area becoming vegetated, and so forth. Factors which influence the rate of change of these habitat types (and therefore their relative proportions) may include agricultural conversion and other land use changes, hydrologic patterns, flooding patterns, and bank protection.

The *linear continuity* of riparian areas, providing a corridor for wildlife movement, is important for several reasons: food may be seasonal, young need to disperse into their own territories, and it allows for the movement of individuals into and out of areas, thus ensuring a good mix of genetic material into a population. Corridors serve as a connection between large blocks of high quality habitat.

The entire riparian forest is valuable for wildlife, but even a single tree species can support wildlife in a surprisingly wide variety of ways. The life cycle of the valley oak tree provides a good example. As an oak matures, its spreading canopy provides numerous nesting sites; the spring flowers attract many insects, which in turn become food for the nesting birds. Other wildlife are also attracted to the new leaf material as it emerges in the spring. Acorns from oaks and the fruits from understory plants such as coffee berry, wild grape and poison oak serve as important food sources for many wildlife species. Acorn production decreases as the tree ages, but populations of wood boring insects increase in the decaying wood, and nesting cavities become more common. Cavities provide nesting sites for the acorn woodpecker, owl, western bluebird, American kestrel, and other birds. When the tree dies, the snag will serve as an important perching, roosting or nesting site, as well as providing insects for food. Dead and down woody materials provide both forage sites and cover for small mammals, reptiles and amphibians.

The California Wildlife Habitat Relationships (CWHR) database was used to predict which wildlife species could be found along the Sacramento River (DFG, 1996). More than 250 species of mammals, amphibians, reptiles and birds were listed (Appendix B).

Fragmentation of Habitat

The historical changes to riparian habitat described earlier have resulted in habitat fragmentation, a condition that occurs when a large, fairly continuous tract of vegetation is converted to other vegetative types such that only scattered fragments of the original habitat type remain. Habitat fragmentation affects riparian wildlife species in several ways, including loss of habitat, increased edge habitat and edge effect, and isolation effects. The species that habitat fragmentation most adversely affects include those with large home range sizes, narrow or very specific habitat requirements, and sedentary species with little ability to disperse.

Each wildlife species requires a specific arrangement of food, water, and cover to meet its biological needs. In addition, each species requires a minimum amount of suitable habitat (space). Western yellow-billed cuckoos require deciduous riparian thickets or forests with dense, low or understory cover by slow moving water-courses. This species generally selects these habitats for nesting only if they are present in contiguous stands of at least 25 acres and are 300 feet in width (Gaines, 1974). Smaller or narrower stands of suitable habitat are rarely used. When the minimum home range size is greater than the fragment size the species frequently disappears. So, a consequence of habitat fragmentation is a reduction in species richness and diversity with the greatest effects on the smaller or linear shaped fragments.

Riparian wildlife species may be absent from a fragment of apparently suitable habitat even if the fragment greatly exceeds the minimum home range size due to edge effects. An edge is the area where two habitat types, or seral stages meet. The edge habitat generally contains species from each of the intersecting habitat types or seral stages and species adapted to the edge habitat itself. This characteristic of edges is known as edge effect. Because edges increase species diversity and many game species are adapted to edges, most historic wildlife habitat improvement projects have attempted to create edge habitats. As habitat fragmentation occurs, however, the amount of edge increases relative to the amount of interior area. This further serves to reduce the quality and amount of habitat for interior species. The qualitative habitat reduction due to edge effects on fragmented habitats has been documented for forest birds and includes increased rates of nest predation, brood parasitism, interspecific competition, as well as reduced pairing and nesting success. These edge effects have been documented to extend 150 feet to 1800 feet into the interior of the fragmented forest habitats.

Isolation effects lessen a species' ability to move between fragments. The dispersal ability of a species and the characteristics of the habitat between fragments are key factors that determine the relative degree of isolation. Island biogeography theory suggests that isolated fragments may support lower densities and diversities than similar sized fragments with less isolation and that the long term potential for population survival is less. Avian (birds and bats) species generally have excellent dispersal capabilities while small mammals and some species of reptiles and amphibians are significantly poorer.

Management of fragmented habitats should be guided by the following principles:

- Larger fragments are better than small fragments.
- Efforts to protect, acquire, or create larger blocks of habitat should be a priority.
- In situations involving equal amounts of habitat, one large fragment is better than several smaller isolated fragments.

- Several fragments located close together is better than equivalent sized fragments with greater relative isolation.
- Interconnected fragments are better than isolated fragments.
- A fragment with a greater ratio of interior area relative to perimeter length is superior to a fragment with a lower ratio of interior area relative to perimeter length (linear shaped habitats are poorer than circular shaped fragments).

Sensitive Wildlife Species

Historically, there have been many sensitive wildlife species within the Sacramento River Conservation Area, including several that have been extirpated (Appendix B). (*Sensitive* refers to state or federally listed threatened or endangered species, or species of special concern). Each of the remaining species depends on different habitat types and components of the riparian ecosystem. Many of these species require broad and unfragmented habitat areas. The least Bell's vireo, considered the most numerous songbird along the river in the 1940s was completely absent by the early 1960s. This vireo depends upon the willow scrub riparian communities created by river meander. It is thought that willow scrub habitat declined following flood control projects, increasing the vireo's vulnerability to cowbird parasitism and, eventually causing its removal.

The bank swallow is another example of a species that depends upon the dynamic nature of the river system. Swallows make their spring nests in eroding river banks, precisely where landowners install rock revetment to protect their property from erosion. Consequently, this species, once common throughout California, has disappeared throughout much of its historic range. Today the meandering portions of the Sacramento River above Hamilton City support nesting for the majority of the state's remaining bank swallows.

RIPARIAN FOREST SUCCESSION AND AN INNER RIVER ZONE GUIDELINE

The riparian habitat management policies that the SB1086 Advisory Council developed in the *1989 Plan* include the concept of the "inner river zone." The *1989 Plan* recommends that such a zone be established taking into account "the river's natural geologic controls and effects on erosion, riparian ecosystem dynamics, existing land uses including agriculture, and structures such as buildings, bridges and levees that must be protected from bank erosion. Within the zone, the natural river processes of erosion and deposition would be allowed to occur for the most part unhindered by human intervention" (Resources Agency, 1989). Because participation in Conservation Area programs will be strictly voluntary, the inner river zone will actually include Only the properties of those public and private landowners who choose to participate.

The inner river zone guideline combines the past 100-year meanderbelt with projected erosion locations 50 years in the future (Figure 2-13).

1. The 100-year Meanderbelt

The 100-year meanderbelt is the combination of all channel locations between 1896 and 1991. In other words, it is that area along the river that has experienced channel movement in the immediate past.

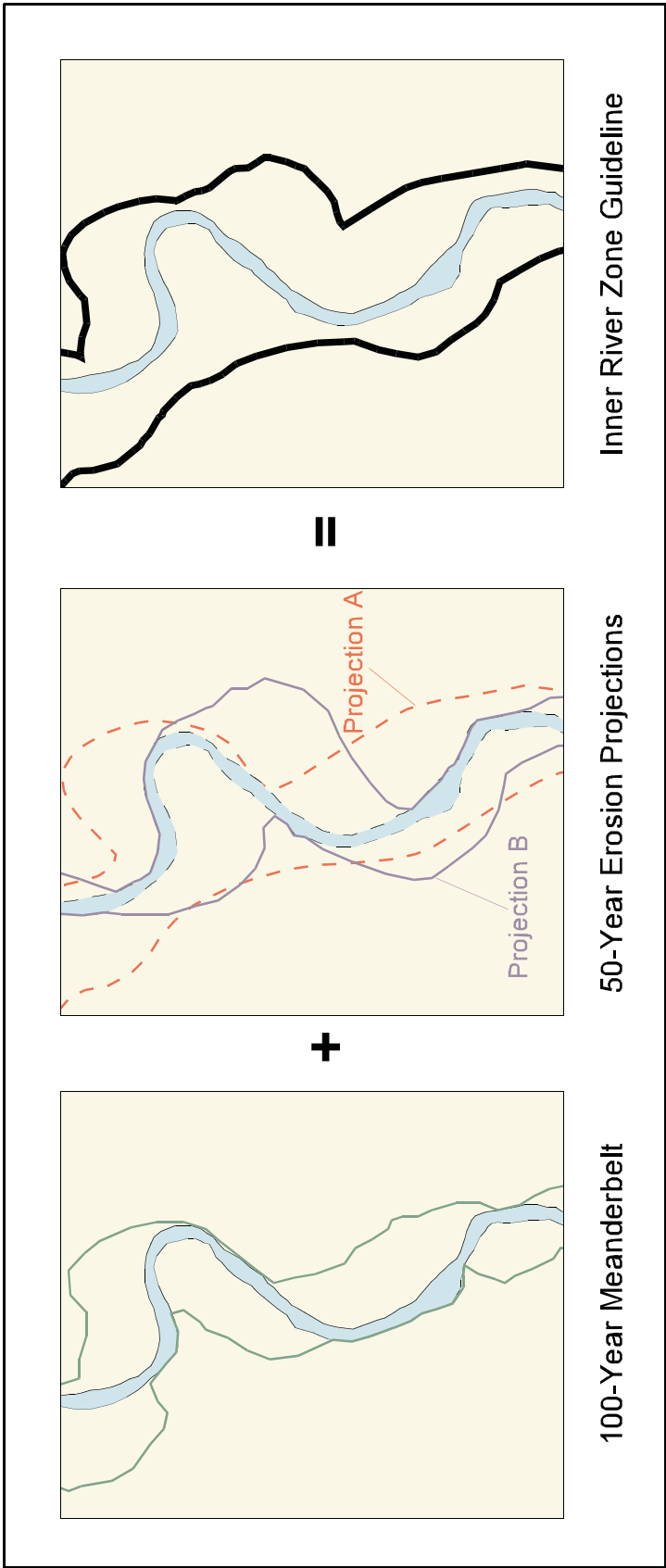


Figure 2-23. The 100-year meanderbelt is combined with 50-year erosion projections developed by U.S. Army Corps of Engineers (Projection A) and California Department of Water Resources (Projection B).

Interestingly, 100 years also represents the approximate life span of a cottonwood tree. In theory, any area along the Sacramento River that has not been channel bottom since 1896 has had time to grow into a mature riparian forest on its way to becoming high terrace valley oak woodland. The successional stages of riparian forest generally occur within the band represented by the 100-year meanderbelt. Outside of the 100-year meanderbelt, forests will intergrade into valley oak woodland.

2. Erosion Projections

Erosion projections are also used to develop the inner river zone guidelines. Data from the Department of Water Resources (DWR) and the U.S. Army Corps of Engineers (USACE) are used to determine probable channel locations over a 50-year timeline.

DWR developed erosion estimates for two hypothetical scenarios:

1. Erosion is projected under the assumption that all public and private bank stabilization remains in place. This scenario provides a baseline for analysis purposes.
2. Erosion is projected over fifty years (since 1991) in the absence of all existing rip-rap. Although as unlikely as the first, this scenario provides a picture of the physical potential for channel migration and is used for the inner river zone guideline.

Many possible sources of error can affect the results of an erosion analysis. Erosion rates do not progress linearly, but change as the bank curvature and hydraulic factors change. Rock revetment installed at one site may affect erosion rates and patterns both upstream and downstream. Also, storms may occur that cause major channel realignments through chute cutoffs or other mechanisms (DWR, 1994).

The USACE has made very general projections of channel locations in 50 years (USACE, 1981). An examination of these projections indicates erosion in areas where DWR has not predicted it would occur. This *Handbook* uses the USACE projections along with the DWR projections to define an inner river zone guideline between Chico Landing and Red Bluff and DWR projections to define the guidelines between Colusa and Chico Landing. Because the river channel is closely confined by Sacramento River Flood Control Project Levees from Colusa to Verona and by geologic control from Keswick to Red Bluff, different criteria were used to develop the guidelines for these reaches.

The combined area of the 100- year meanderbelt and 50-year erosion projections is referred to as an inner river zone *guideline* because several factors will influence its actual location:

- Participation in programs; the inner river zone will include only voluntary public and private landowners;
- Unpredicted changes in channel alignment
- Individual decisions to install bank protection

A landowner choosing to participate in riparian habitat conservation programs offered by the nonprofit management entity or others, will work with the entity to develop a site-specific management plan (Chapter 9). A technical team of specialists familiar with the area will assist with the development of this plan. Many of the parameters to be used in analyzing the site and developing the plan are mapped and available in the Sacramento River Geographic Information System (Appendix C). These include:

1. geology
2. channel movement history
3. projected erosion
4. land use
5. roads, bridges
6. water diversions
7. federally installed bank protection
8. soils
9. riparian habitat
10. bank face characteristics

This information will be used to assess the site, develop a site-specific management plan, and assess its merit in terms of the mission of the nonprofit management entity.

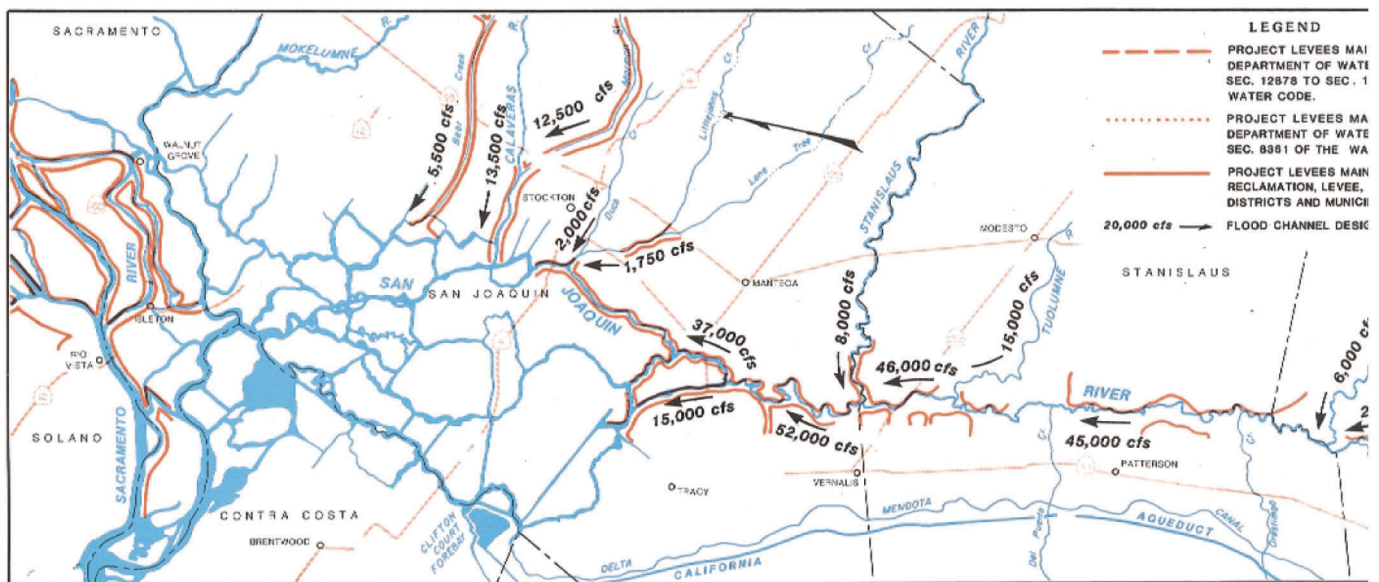
THE SACRAMENTO RIVER FLOOD CONTROL PROJECT

All riparian habitat management along the river must be placed in the context of the Sacramento River Flood Control Project, described in the following section. The project affects riparian habitat in different ways in the four broad reaches. The Keswick-Red Bluff and Red Bluff-Chico Landing Reaches lie upstream of the Flood Control Project. The Chico Landing-Colusa Reach includes the upstream end of the project at the Butte Basin Overflow Area (BBOA). The reach is characterized by the setback levees of the project (Chapter 5). Any riparian habitat management within this reach must be coordinated with the Reclamation Board and the U.S. Army Corps of Engineers (USACE). The Colusa-Verona Reach (Chapter 6) lies within the portion of the project that is tightly leveed. As stated earlier, any riparian habitat management in this reach must be coordinated with the flood control agencies.

Many individual flood control elements make up the Sacramento River Flood Control Project (Figure 2-14). Congress authorized the overall project in 1917 and modified it by the various Flood Control and/or River and Harbor Acts of 1928, 1937, and 1941. Construction began in 1918, and the overall project was completed in 1968.

The major features of the Sacramento River Flood Control Project are:

- the greatly enlarged river channel from Rio Vista to Collinsville
- approximately 1,300 miles of levees along the Sacramento River extending from River Mile (RM) 0 at Collinsville to RM 194 at Chico Landing, distributary sloughs, the lower reaches of the major tributaries (American, Feather, Yuba and Bear Rivers) and additional minor tributaries;
- the Moulton, Colusa, Tisdale, Fremont, and Sacramento Flood Overflow Weirs;
- the Sutter and Yolo Bypasses and Sloughs; and
- the Flood Relief Structures within the Butte Basin Overflow Area.

[illegible]

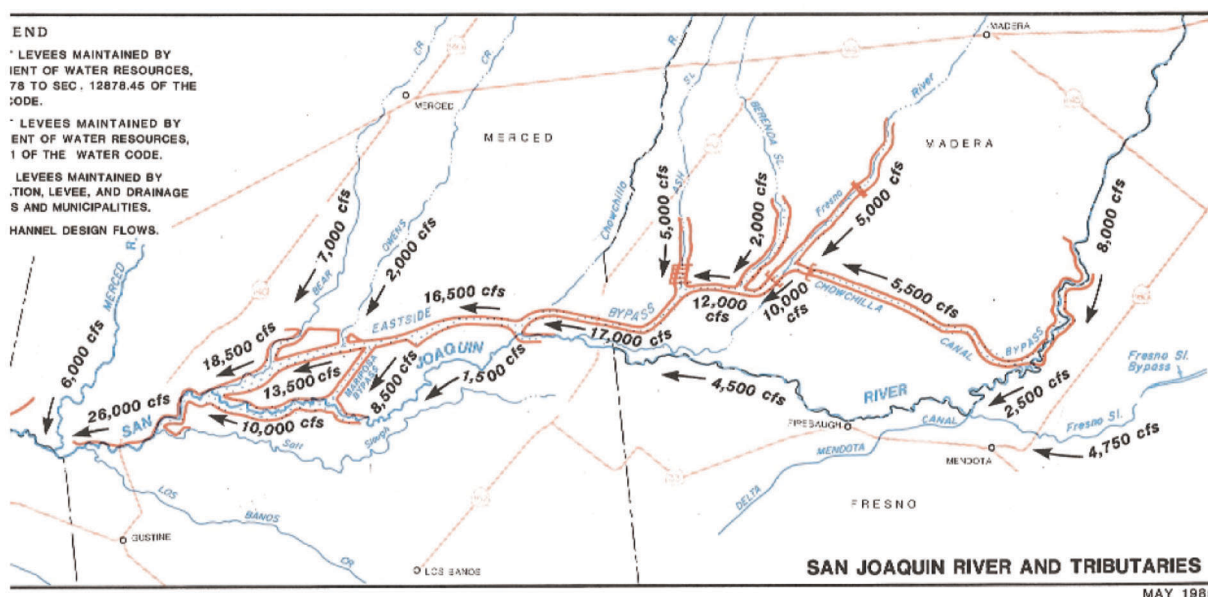
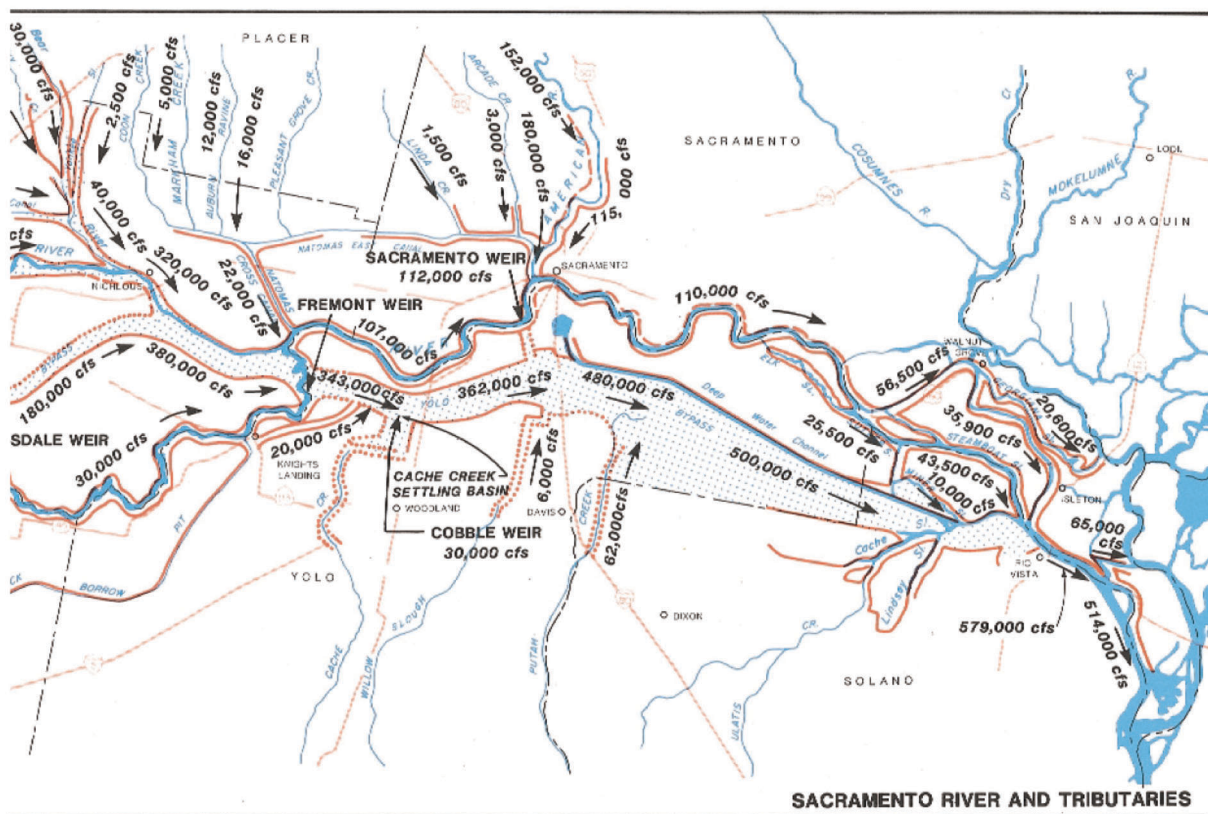


Figure 2-14. Sacramento Valley Flood Control System

The flood control project protects about 800,000 acres of agricultural land, as well as the cities of Sacramento, West Sacramento, Yuba City, Marysville, Colusa, Gridley, Live Oak, Courtland, Isleton, Rio Vista and numerous smaller communities. Several economically significant crops are grown throughout the basin; orchards and field crops such as almonds, pears, peaches, rice, tomatoes, sugar beets, and corn are the most prevalent. Sacramento Valley's annual agricultural production exceeds \$2 billion. Infrastructure within the valley includes irrigation works (diversions, pumping plants, canals and drains), roads and bridges. Major transportation routes are Interstate Highways 5 and 80, and State Highways 50, 99, 45, 20 and 160.

During major flood events, upstream reservoirs intercept and store initial surges of runoff and provide a means of regulating floodflow releases to downstream leveed streams, enlarged channels, and bypass floodways. In order to achieve the full benefits of the reservoirs, specific downstream channel capacities must be maintained. Reservoir operation is coordinated not only among various storage projects but also with downstream channel and floodway carrying capacities.

Shasta Dam is a major structural feature of the basin. This multipurpose dam controls runoff from 6,420 square miles (excluding Goose Lake), and serves agricultural demands by providing 4.5 million acre-feet (af) of total storage, 1.3 million af of which is allocated to flood control. At Colusa, the drainage area below the dam is 6,180 square miles. The only flow control in the reach from Shasta Dam to Colusa is on Stony Creek where Black Butte Dam creates a 144,000 af multipurpose reservoir.

The Sacramento River Flood Control Project basically mimics the natural historic flooding patterns with its system of levees, basins, bypasses and weirs. The project levees begin on the right (west) bank just downstream of the Butte Basin Overflow Area (BBOA). The BBOA, located roughly between RM 174 and 194, includes three flood relief structures (3 B's, Goose Lake, and M&T) that allow for high flows on the river to drain into the Butte Basin, a trough created by subsidence, to the east. The Colusa Basin Drain, a similar trough located to the west of the river, intercepts runoff from west side tributaries.

In addition to the basins and flood relief structures, the flood control system includes several weirs. The Tisdale Weir is the first flood relief structure to spill at 23,000 cubic-feet per second (cfs), which is quite frequent. Colusa Weir is the next structure to spill at 30,000 cfs, and the Moulton at 60,000 cfs. By comparison, the BBOA begins to spill at 90,000 cfs, and if flood flows exceed 300,000 cfs, the Sacramento River would be expected to spill into the Colusa Basin.

Oroville Dam provides 3.5 million af of storage for several purposes; 750,000 af of storage is allocated to flood control to provide roughly a 140-year level of protection downstream.

The north fork of the Yuba River is uncontrolled except for New Bullards Bar, which provides 960,000 af of storage (170,000 af is for flood control). The 50-mile long by 7-mile wide Yolo Bypass provides 1.11 million af of flood storage. Prior to hydraulic mining, the Feather River had deep (60-foot) pools that would take months to drain. Now these pools are filled with debris and no longer provide flood flow detention and attenuation.

Sacramento River Bank Protection Project

To ensure that the flood control project continues to provide a design level of flood protection and to reduce the need for emergency levee repair, periodic dredging and loss of land due to bank erosion, Congress authorized the Sacramento River Bank Protection Project in 1960 in Public Law 86-645, and in subsequent acts of Congress. The Flood Control Act of 1960 authorized construction of the first phase of the project. The second phase of the project was authorized by the 1974 River Basin Monetary Act, the Further Continuing Appropriation Act of 1993 (which extended the authority into the Butte Basin), and the Water Resources Development Act of 1986 (which also authorized environmental mitigation for the first phase of the project). The bank protection project provides a long-range program to protect the flood control system from erosion. The project includes a total of 835,000 lineal feet of bank protection in two phases: 430,000 lineal feet in the first phase (carried out between 1963 and 1974) and 405,000 lineal feet in the second (began in 1974).

Approximately 86,000 feet of the second phase has not yet been completed. Of this amount, between 16,000 and 31,000 lineal feet (best current estimate of about 26,000 lineal feet) are currently being designed in Design Memorandum Supplements 7 and 8 for sites on the Sacramento and American Rivers.

In the late 1950s, the levees were deteriorating rapidly and the bank protection project was authorized. It is important to note that this project is an "O&M" (operation and maintenance) project authorized in lieu of providing bank protection in the original authorization of the flood control project. In the authorizing documents for the initial phase of the project (HD 103, 86th Congress, 1960), USACE performed a gross economic evaluation. Upon review by the Board of Engineers for Rivers and Harbors (BERH), and confirmed by the Chief of Engineers, it was determined that economic justification was not needed. The following was included as paragraph 12 of the BERH report:

The Board considers that the remedial work is clearly justified to preserve the integrity of the existing levee system, the failure of any part of which would endanger lives and cause extensive property damage. The improvements would also reduce the need for emergency expenditures and the costs of maintenance dredging for navigation and flood control channels. The Board considers it impractical to assign a monetary value to the benefits which would result from the removal of threats of eventual levee breaks when there are hundreds of vulnerable locations in various states of deterioration.

The second phase of the bank protection project was authorized according to HD 93-151 of the 93rd Congress (1973). This report indicated that the views of the BERH on the initial phase of the project also were applicable to the second phase work.

The current phase of the Sacramento River Bank Protection project was authorized in 1973. This authorization was for a total of 405,000 linear feet of protection of which 82,000 linear feet of protection was identified at that time and 323,000 linear feet was expected to be critical in future years (specific sites would be determined later). To date, bank protection has been or is being provided to approximately 335,000 linear feet leaving only 70,000 linear feet remaining to be designed and built.

Most of the bank protection work placed to date has been either where levees eroded that were constructed adjacent to the channels with no berms, or where

berms eroded and active erosion threatened the safety of the levee. To adequately protect the levees in such areas, it has been necessary to clear the waterside levee or berm slope, grade the slope and face it with stone.

Recreationists and conservationists have objected strongly to the aesthetic and wildlife losses that occur when native vegetation is removed from the river levee or berm slope and the slope is faced with stone. There is strong interest in developing a more comprehensive program of bank protection on the berms and levees which would not only protect the levee system, but could also preserve riparian environmental values. These ideas were expressed as early as 1973 in House Document (HD) 93-151 of the 93rd Congress.

The need for bank protection is a “built-in” design feature of the Sacramento River Flood Control Project. Originally, the project levees for the main stem of the Sacramento River and its major tributaries were set close together to provide for two of the original purposes for the Corps: (1) to maintain summer flows deep enough to accommodate navigation and (2) to keep hydraulic mining debris moving (through scouring of the channel). As a result of the original design, especially now that the mining debris has essentially passed through the system, erosion is a serious problem. This has long been recognized, causing the state and the USACE to place both riprap and setback levees years before the bank protection project began.

The Sacramento and San Joaquin Rivers as a Comprehensive Study

The “Comprehensive Study” was authorized in 1997/98 through joint actions of Congress and the California State Legislature. It is a joint study by the California State Reclamation Board and the U.S. Army Corps of Engineers to “develop a system-wide, comprehensive flood management plan for the Central Valley to reduce flood damages and integrate ecosystem restoration”

- Phase I focused on evaluating current conditions, developing hydrologic and hydraulic models, identifying flooding and related environmental problems, formulating preliminary planning objectives, initiating a public involvement program, collecting potential solution measures, and developing a plan of action for Phase II.
- Phase II is concentrating on fully implementing the public involvement program, conducting feasibility-level assessments, developing concept approaches and the Starting Point Plan.

Keswick Dam –Red Bluff Reach

The Keswick-Red Bluff Reach of the Sacramento River, the upper-most reach of the Conservation Area, is unique in many ways.

The reach extends from Keswick Dam (about 10 miles below Shasta Dam) downstream through the cities of Redding and Anderson, past Bloody Island, through Iron Canyon and the City of Red Bluff to the Red Bluff Diversion Dam (Figure 3-1 and Table 3-1). The broad alluvial portion of the reach between Redding and Balls Ferry has the potential to support significant tracts of riparian forest. Along much of the reach, however, riparian forests are confined to narrow corridors at the base of canyon walls. It is the most urbanized and industrialized of the four reaches, while also supporting agriculture. It has three water control structures (Keswick, Anderson- Cottonwood Irrigation District, and Red Bluff Diversion Dams). Historically the river between Redding and Anderson supported several gravel mining operations.

In its 1989 Plan, the SB1086 Advisory Council recommended the establishment of a Conservation Area along the Sacramento River. The Conservation Area includes an inner river zone that would define the locations where interested landowners may participate in voluntary riparian habitat conservation and restoration programs administered or coordinated by the Sacramento River Conservation Area Forum. In 2001, the Sacramento River Conservation Area Board adopted guide lines for the inner river zones. The purpose of the inner river zone guideline is to focus the preservation and reestablishment of a continuous riparian ecosystem on the erosion and flood-prone areas along the Sacramento River in a manner that:

- Uses an ecosystem approach that provides for recovery of threatened and endangered species and is sustainable by natural processes;
- Gives full consideration to local, state and federal flood control and bank protection programs;
- Works only with voluntary participants;
- Gives full consideration to landowner, public, and local government concerns;

Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;

Provides for the accurate and accessible information and education that is essential to sound resource management.

The Keswick-Red Bluff portion of the Conservation Area includes all areas within the 100-year flood-plain, existing areas of riparian bottomlands, and all areas of contiguous valley oak woodland. It encompasses approximately 22,000 acres, ranging in width from more than one mile wide in the broad alluvial area near Bloody Island to only 500 feet in the confined canyon near Table Mountain and within Iron Canyon.

Keswick Dam – Red Bluff Reach

Shasta Dam, hydrologic operations, urbanization, and gravel mining operations have disrupted the physical processes that shape riparian forest development in this reach. However, there are still tracts of riparian habitat, and some flooding and channel movement still occur.

Table 3-1. *Features of the Keswick—Red Bluff Reach*

RIVER MILE	FEATURE	RIVER MILE	FEATURE
302	Keswick Dam	271L	Mouth of Battle Creek
301R	Middle Creek	268R	Mouth of Frazier Creek
300R	Mouth of Salt Creek	267	Jellys Ferry Bridge
299	Lake Redding	265L	Mouth of Inks Creek
299	Southern Pacific Rail Road	258	Bend Bridge
298	Redding Diversion Dam	258	Bend Ferry
297	Highway 299	255L	Bend
295	Cypress Avenue Bridge	253L	Mouth of Paynes Creek
290R	Mouth of Clear Creek	252R	Bald Hill
290R	Olney Creek	251L	Mouth of Sevenmile Creek
285L	Mouth of Churn Creek	248R	Mouth of Blue Tent Creek
285	Interstate 5	247R	Mouth of Dibble Creek
284R/L	Anderson	246R	Mouth of Brewery Creek
284	Airport Road	246	Interstate 5
281	Deschutes Bridge	245R	Mouth of Reeds Creek
281L	Mouth of Stillwater Creek	245R	Brickyard Creek
278L	Mouth of Bear Creek	245R/L	Red Bluff
278L	Dry Creek	244L	Mouth of East Sand Slough
277L	Mouth of Ash Creek	244	Interstate 5
276	Balls Ferry Bridge	244L	Samson Slough
274R	Mouth of Anderson Creek	244L	Paynes Creek Slough
273L	Bloody Island	243	Red Bluff Diversion Dam
273R	Mouth of Cottonwood Creek	243R	Mouth of Red Bank Creek

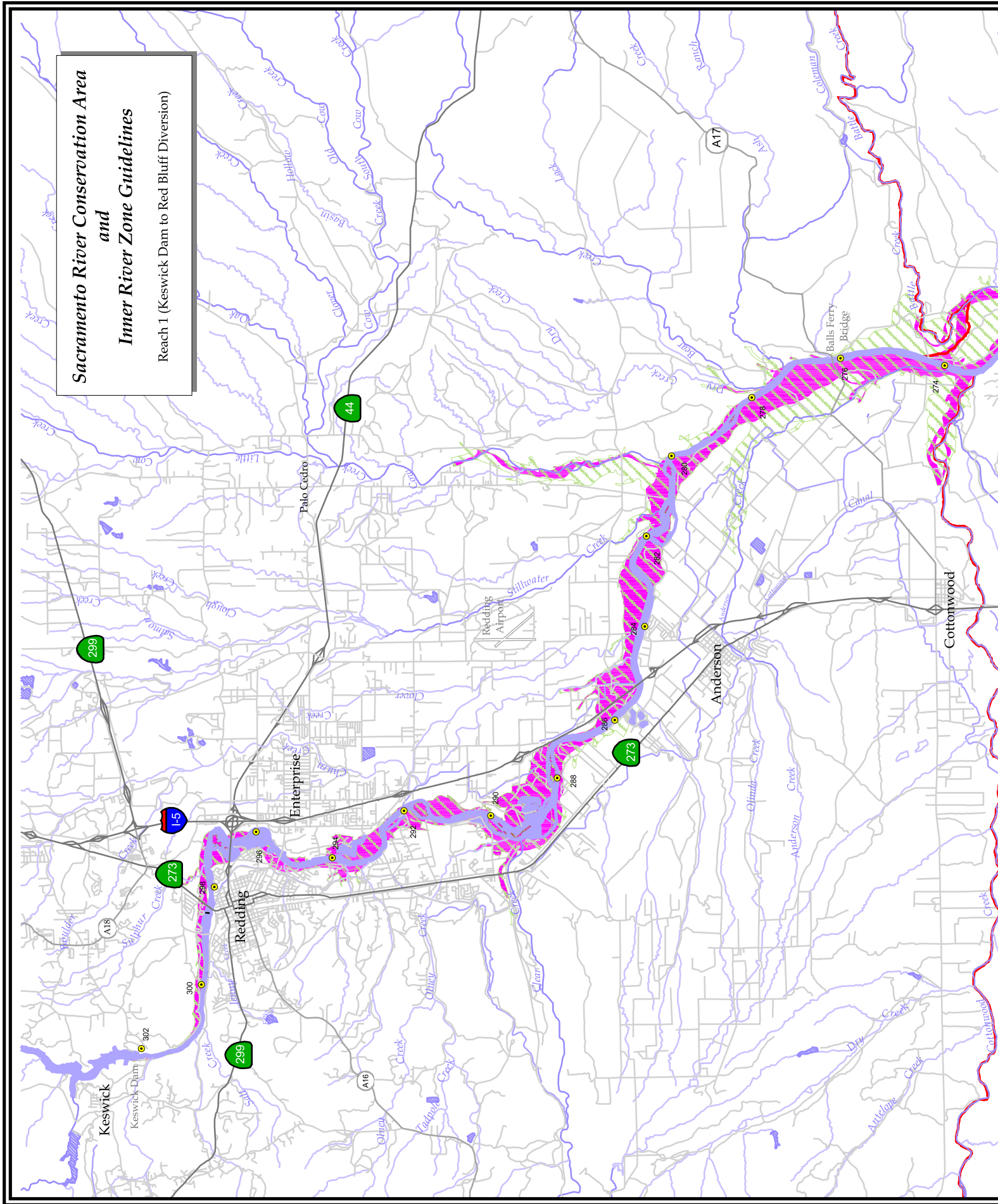
PHYSICAL SETTING

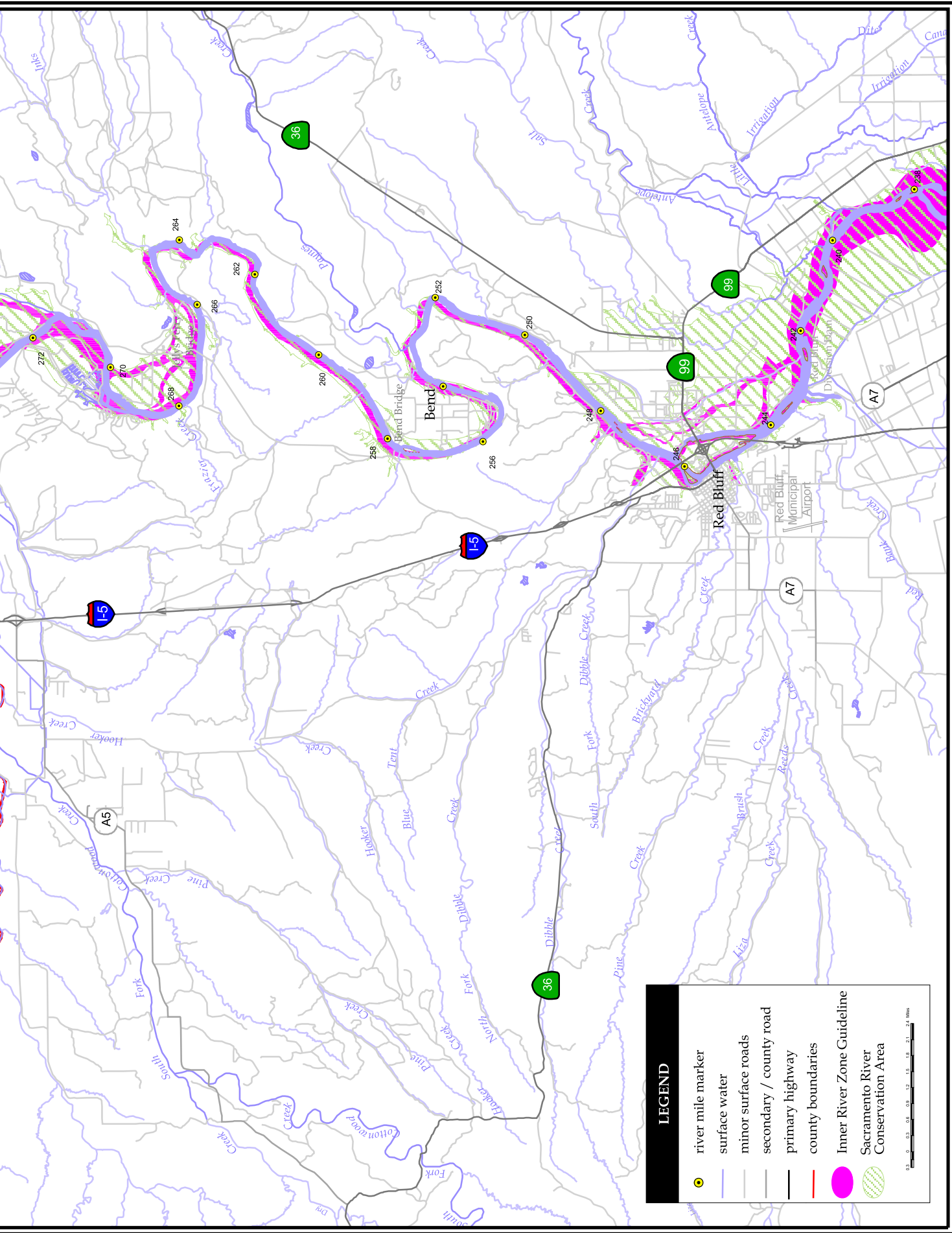
Geology and Soils

The geologic characteristics of this reach vary greatly. From Keswick Dam to Redding the river flows through volcanic and sedimentary formations. The canyon is relatively narrow here with little floodplain and a correspondingly narrow riparian corridor. From Redding to the Cow Creek confluence there are limited areas where the river has meandered over a broader floodplain of alluvium derived from the Klamath Mountains and the Coast Ranges. From the Cow Creek confluence to near Red Bluff the river is almost entirely controlled by the Tuscan Formation (DWR, 1981). Here the channel is often narrow and deep, between high canyon walls. Table Mountain, a two-mile long volcanic plateau adjacent to the river and steep-sloped Iron Canyon (RM 250-253) are both examples of Tuscan Formation outcrops. At Red Bluff the river flows out onto the broad alluvial floodplain of the Sacramento Valley.

Sacramento River Conservation Area and Inner River Zone Guidelines

Reach 1 (Keswick Dam to Red Bluff Diversion)





LEGEND

river mile marker

surface water

minor surface roads

secondary / county road

primary highway

county boundaries

Inner River Zone Guideline

Sacramento River Conservation Area

0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 Miles

The potential for riparian habitat restoration is closely related to soils and geology. Portions of the Keswick–Red Bluff Reach have deep loamy soils suitable for both agricultural use and the growth of riparian forests. Much of the proposed Conservation Area, however, contains cobbly alluvial lands and gravel pits (USDA, 1974).

Historical Channel Movement

Channel movement in this reach has been mapped as far back as 1860 (DWR, 1980). Most movement has taken place in three sub-reaches (Figure 3-2), with a combined land surface area of approximately 2,240 acres. Channel movement is inhibited primarily because of geologic factors. Bank protection minimizes erosion in some of the urban areas (DWR, 1981).

Sediment Transport

The bed material and floodplain deposits of this portion of the Sacramento River consist generally of well-rounded material composed of various metamorphic, sedimentary, and igneous rocks. The size of this material ranges from clay fines to boulders (DWR, 1981). Since the closure of Shasta Dam in December of 1943, the transport of sediment from reaches upstream of the dam has ceased. As it flows from Keswick Dam, the water of the Sacramento River is “hungry,” with a large Capacity to transport sediment. This has resulted in an armored channel surface below the dam as the river has transported sediments out of the area (DWR, 1981).

Two other factors influence the sediment supply in this reach:

1. The urbanization of the Redding-Anderson area and increasing value of river-front property has resulted in reduced bank erosion due to the installation of bank protection and levees.
2. Large quantities of sand and gravel are being mined at locations in and adjacent to the Sacramento River and its tributaries (DWR, 1981). Because tributaries contribute a significant amount of sediment to the river, the effects of the lower sediment supply to the river are less obvious with distance downstream.

Hydrology and Tributaries

The Keswick-Red Bluff Reach is highly influenced by the altered hydrology resulting from the operation of the Central Valley Project (CVP). The operation of the CVP in this reach includes Shasta and Keswick Dams on the main stem of the Sacramento River as well as the diversion of Trinity River and Clear Creek water to Keswick Reservoir via the Spring Creek tunnel.

Central Valley Project operation reduces flood peaks during the winter and spring and increases discharge between floods during the summer and autumn. For example, without the CVP a 100-year flood (a flood with a probability of occurring one time in 100 years) is calculated to be about 336,000 cubic feet per second (cfs) at Bend Bridge. Under the controlled operation of the project, however, this is reduced to 202,000 cfs. A smaller 2-year flood (a flood with a probability of occurring 50 times in 100 years) is reduced from 110,000 cfs to 70,800 cfs (TNC, 1996). During July, August and September, the mean monthly flows of the Sacramento River at Keswick since 1963 are nearly 400 percent higher than the mean monthly flows

prior to 1943 (DWR, 1981). The effect of these changes to hydrology is most obvious directly below the dams. Because of the influence of tributaries with distance downstream, the hydrologic changes due to the Central Valley Project are less pronounced in the lower reaches. The principal west side tributaries to the Sacramento River in the Keswick-Red Bluff Reach include Clear, Cottonwood and Dibble Creeks. These creeks flow from the valley floor and parts of the Klamath Mountains to the Sacramento River. Main east side tributaries include Churn, Stillwater, Cow, Bear, Ash, Battle and Paynes Creeks. Battle and Paynes Creeks originate in Cascade mountains east of Redding and flow through confined canyons before joining the Sacramento River. Riparian corridors along the tributaries provide important connections for wildlife between the Sacramento Valley and the surrounding foothills and mountains.

Land Use

The Keswick-Red Bluff Reach has a variety of land uses—urban, residential, industrial and agricultural. About 35 percent of the area is in agriculture, and about 12 percent is urban, residential or industrial (Table 3-2). The most predominant agricultural crop within the Conservation Area is walnuts, (1,920 acres) with mixed pasture (989 acres) and prunes (708 acres) also important. Land use acreage was determined using DWR land use surveys (DWR, 1994; DWR 1990), and overlaying this information with the Conservation Area boundary.

Industrial land uses within the Conservation Area in this reach include lumber mills and gravel removal operations. Because the Conservation Area includes the cities of Redding, Anderson, and Red Bluff, residential and commercial land uses are common as well. This reach has the most recreational facilities on the river.

Table 3-2. *Land use, Keswick-Red Bluff Reach*

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	1,334	17%	6,459	35%
Riparian Vegetation	1,490	19%	2,191*	12%*
Upland Vegetation	3,274	41%	6,210*	34%
Urban	852	11%	2,188	12%
Water Surface (excluding main channel)	372	5%	644	3%
Miscellaneous (includes barren)	643	8%	767	4%
Total Land Surface Area	7,965	101%	18,459	100%
Channel Surface Area	3,005		3,005	
Total	10,970		21,464	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for the most accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding.

RIPARIAN VEGETATION

Current Acreage

The most current survey of the riparian resources within this reach is based on aerial interpretation of 1999 photos. The survey was performed by the Geographic Information Center at California State University, Chico. There are 4,674 acres of riparian habitat within the Conservation Area.

Table 3-3 presents a summary of the riparian and closely related habitats within the Conservation Area. Because portions of the channel within this reach are geologically confined, the width of riparian vegetation is often very narrow (Figures 3-3 and 3-4). Areas with potential for the development of large tracts of riparian vegetation are often converted to agriculture or are under other types of development. Approximately 128 acres of valley oak woodland are contiguous with the outer boundaries of the 100 year flood line.

Unlike the downstream reaches, a large amount of native upland vegetation (such as chaparral and various woodland types) occurs within the Keswick-Red Bluff Reach. A total of 6210 acres of these vegetation types occur within the Conservation Area, often functioning as “buffer” areas between the river habitats and developed areas. Native vegetation (both riparian and non-riparian) currently represents almost 40 percent of the total land surface of the Conservation Area.

Table 3-3. *Riparian and closely related habitats within the Conservation Area, Keswick –Red Bluff Reach*

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	2,022	25%	2,801	15%
Riparian Scrub	1,101	14%	1,439	8%
Valley Oak Woodland	218	3%	315	2%
Marsh	49	<1%	58	<1%
Blackberry Scrub	37	<1%	61	<1%
Total Riparian Vegetation	3,427	43%	4,674	26%



Figure 3-3. *Narrow corridor of riparian vegetation bordered by native upland vegetation*

Ownership

More than 82 percent of the Conservation Area within the Keswick-Red Bluff Reach is privately owned (Table 3-4). As described in Chapter 3, the Keswick-Red Bluff Reach contains parts of the Sacramento River Area that the Bureau of Land Management (BLM) owns and manages. About 500 of the 12,000 acres that BLM owns lie within the Conservation Area, including approximately 14 miles of river frontage.

Other significant publicly owned parcels that include riparian habitat are holdings by the City of Redding along both banks of the river, and the associated 200-acre Redding Arboretum and Kutrass River Access, a former gravel mining site (RM 287R). California Department of Fish and Game (DFG) owns 264 acres largely in riparian habitat at Anderson River Park, which the City of Anderson manages (RM 282R). DFG's mouth of Cottonwood Creek Wildlife Area (571 acres, RM 273 R) also falls within this reach. The state also owns several fishing and small public access sites. South of Red Bluff, between RM 242L and 243L the U.S. Forest Service (USFS) owns a 299-acre parcel at the Red Bluff Recreation Area. A portion of this parcel is being actively re-stored to riparian habitat in cooperation with the Sacramento River Discovery Center (Chapter 7).

Table 3-4. *Land ownership within the Conservation Area, Keswick-Red Bluff Reach*

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	5,799	73%	15,067	82%
Public				
Federal	786	10%	1,556	8%
State	551	7%	945	5%
Local District, City, County	848	11%	906	5%
Total (Land Surface Area)	7,984	101%	18,474	100%
Channel Surface Area	3,005		3,005	
Total:	10,989		21,479	

DWR Sacramento River GIS (May 2000); DPR (1994). Rounded to nearest 100 acres.

Restoration Strategy

Restoration activities carried out through the SB1086 program shall be conducted in a manner that:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;

- Participation by private landowners and affected local entities is voluntary, never mandatory
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

Inner River Zone Guideline

The inner river zone guideline for Reach 1 consists of the combined width of the 100-year meander-belt and recent river alluvium, including both channel and over-bank deposits, within the Sacramento River Conservation Area. Projects within this reach should be evaluated according to the established restoration priorities (Chapter 1):

1. Protect physical processes where still intact

Because much of the river is contained within a geologically stable corridor, meandering in this reach is limited. A number of areas where the river has moved significantly in the last 100 years, such as the Turtle Bay area near Redding, are either surrounded by urban development or subject to highly regulated flows. Because such development and associated bridges must be protected from bank erosion, the physical processes necessary for river meandering at these locations no longer exist. *Areas such as the meanders near RM 270-272 where erosion, deposition, and establishment of successional stages of riparian forest is still feasible should receive the top priority for protection.* For the Keswick-Red Bluff Reach, however, the natural process of flooding rather than erosion/deposition, has a greater influence on the establishment of riparian vegetation. Areas currently subject to inundation at a fairly frequent interval, such as 2.5 to 4 year events, should be left undisturbed to allow for the natural establishment of riparian vegetation. Figure 3-5 shows the area inundated by a 2.5 year flow near Bend. While much of this area currently supports riparian habitat, the potential for additional habitat is present.

2. Allow riparian forest to reach maturity

Areas of early successional stages such as willow and cottonwood forest exist within the Conservation Area. The protection of these habitats and the more mature stages, either through acquisition or other programs, is necessary to ensure a complex array of habitat types.

3. Restore physical and successional processes

Because of the influence of flooding on the establishment and survival of riparian species in this reach, any feasible method to reestablish a suitable hydrologic regime is desirable. For example, some areas are currently protected from relatively frequent flows by low man-made berms; relocation of these berms to higher elevations of the floodplain would greatly increase the potential for natural habitat restoration. Another method would be the scheduling of regulated flows to coincide with the release of seeds by species such as willows and cottonwoods, thus ensuring the establishment of early successional stages.

4. Conduct reforestation activities

The construction of the Shasta Dam has curtailed the natural flooding cycle that leads to the establishment of riparian habitat, particularly for areas of the Sacramento

River above Cottonwood Creek. Without the reestablishment of a natural hydrologic regime, large tracts of habitat which once supported riparian habitat or currently support remnant stands, may need active reforestation activities. *The first option under this priority should be the re-establishment of areas that contribute to a continuous riparian corridor along the Sacramento River.* Other areas for reforestation should be ranked on the feasibility of linking large tracts of riparian lands or linking to tributaries with established vegetation. Finally, areas such as terraces with potential to support valley oak woodlands, can also serve as buffer areas between the river and developed lands. These should be considered for active reforestation.

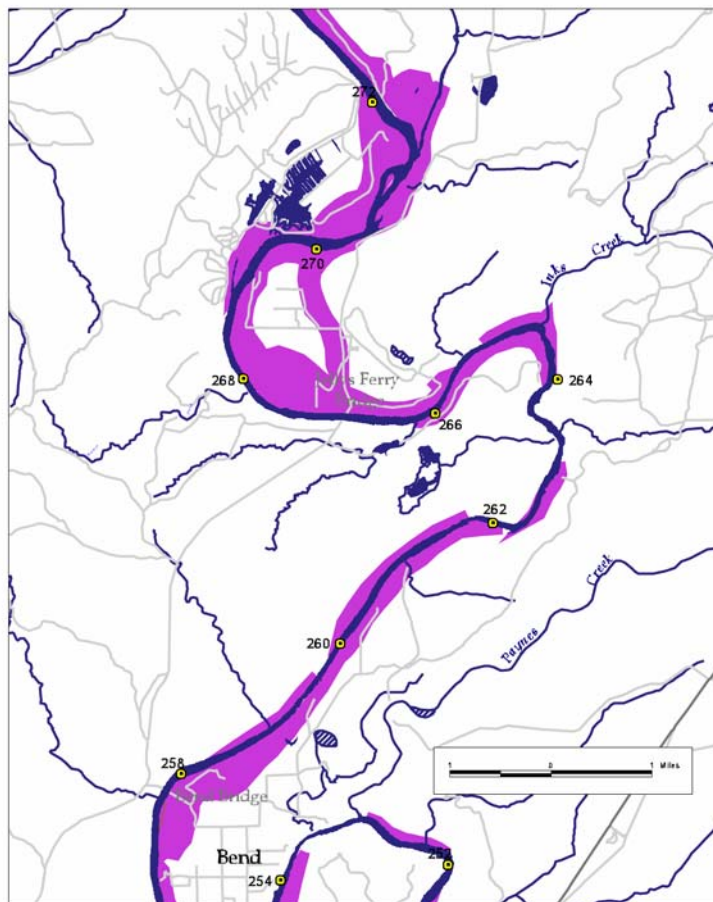


Figure 3-4. Sacramento River near Bend (RM 257-273) showing area inundated by a 2.5 year recurrence interval flood

Red Bluff – Chico Landing Reach

The pattern of riparian forest succession driven by channel movement and flooding is most fully expressed along the Red Bluff–Chico Landing Reach.

With some exceptions, this reach is unleveed and contains significant and substantial remnants of the Sacramento Valley's riparian forest. The floodplain shows a long history of erosion, deposition, and channel migration. The river has recently meandered in deep alluvial soils throughout this reach.

This reach extends from the Red Bluff Diversion Dam downstream past the towns of Tehama, Los Molinos and Nord (Figure 4-1 and Table 4-1). The reach ends at Chico Landing, a site at the mouth of Big Chico Creek that was once a busy riverboat landing. In addition to supporting a mosaic of riparian vegetation, the river floodplain supports a significant portion of the region's walnut orchards, as well as prunes and row crops.

In its *1989 Plan*, the SB1086 Advisory Council recommended the establishment of a Conservation Area along the Sacramento River. The Conservation Area includes an inner river zone that defines the locations where interested landowners may participate in voluntary riparian habitat conservation and restoration programs administered or coordinated by the Sacramento River Conservation Area Forum. Inner river zone guidelines for this reach have been developed (Chapter 2, pages 2-24 through 2-28), and should be incorporated into site specific planning.. The purpose of the inner river zone guideline is to focus the preservation and reestablishment of a continuous riparian ecosystem on the erosion and flood-prone areas along the Sacramento River in a manner that:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

The Red Bluff—Chico Landing portion of the Conservation Area is divided into two sections, split at the southern Tehama County line. In the upper section, the Conservation Area within Shasta and Tehama Counties would include all areas within geologic control, within the 100-year flood-line, and stands of valley oak woodland that are contiguous with this area. In the section south of the Tehama County line, in Butte and Glenn Counties above Chico Landing, the Conservation Area is contiguous with the Inner River Zone Guidelines.

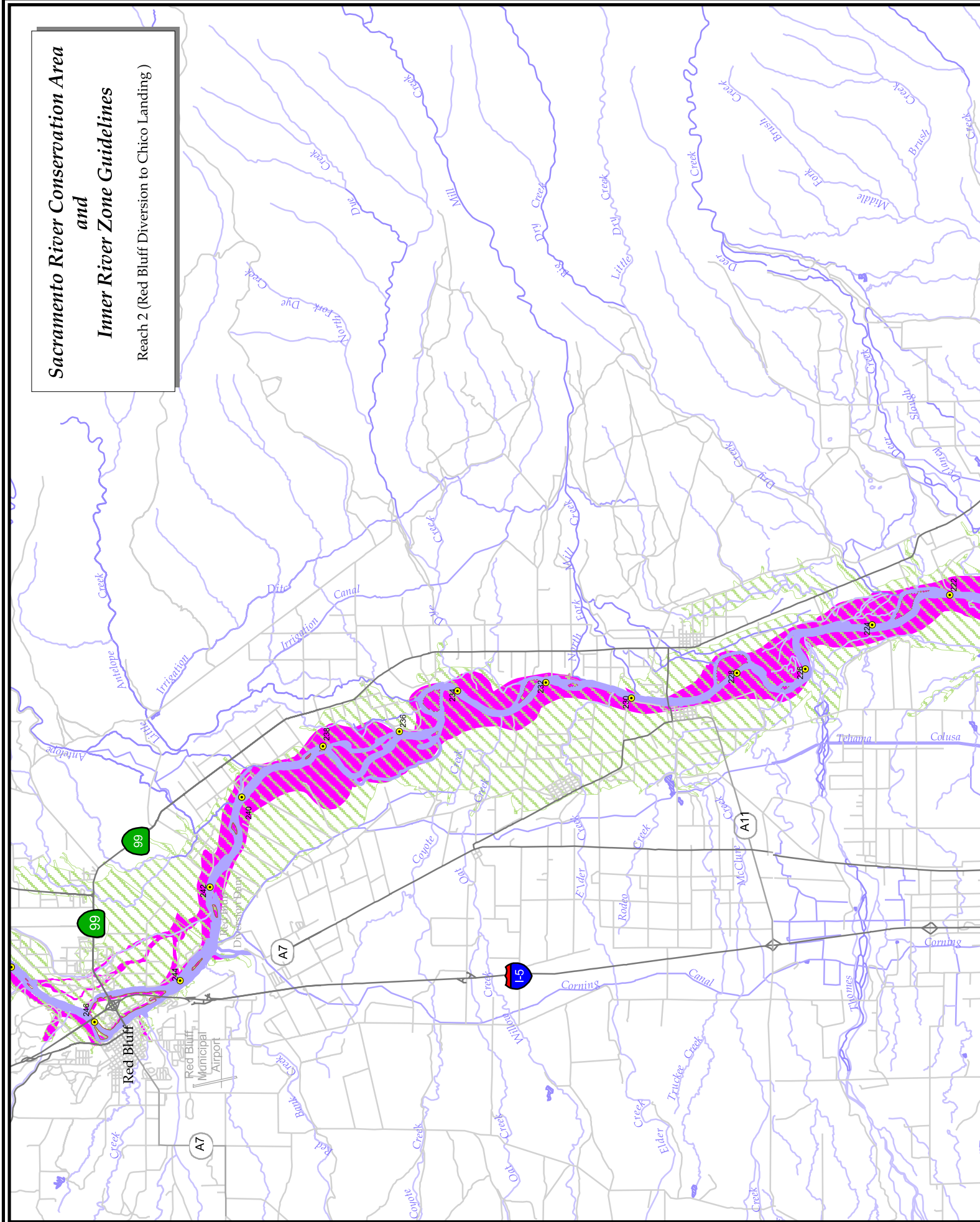
The Inner River Zone Guideline combines the past 100-year meanderbelt with projected erosion locations 50 years in the future.

Table 4-1. *Features of the Red Bluff—Chico Landing Reach*

RIVER MILE	FEATURE	RIVER MILE	FEATURE
243	Red Bluff Diversion Dam	220L	Mouth of China Slough
240L	Mouth of Salt Creek	220L	Mouth of Deer Creek
239L	Blackberry Island	220L	Copeland Bar
239L	Mouth of Craig Creek	219L/R	Woodson Bridge State Recreation Area
237	Todd Island		
236L	Mouth of Butler Slough	218	Woodson Bridge
235R	Sacramento Bar	215R	Mouth of Jewett Creek
235L	Mouth of Antelope Creek	211R	Foster Island
234R	Coyote Creek	210R	Lower Foster Island
234L	Mouth of Dye Creek	209L	Mouth of Dicus Slough
233R	Mouth of Oat Creek	209R	Mouth of Burch Creek
231L	Mouth of North Fork Mill Creek	208L	Mouth of Snaden Slough
230L	Mouth of Mill Creek	207L	Snaden Island
230R	Mouth of Elder Creek	205R	Glenn-Colusa Irrigation District Intake
229R	Tehama		
229	Southern Pacific Rail Road	202R	McIntosh Landing
229L	Los Molinos	199R	Hamilton City
229	Highway 99	199	Gianella Bridge
226R	Mouth of Thomes Creek	198R	Mouth of Dunning Slough
226R	Mouth of McClure Creek	196L	Kusal Slough
225L	Champlin Slough	196L	Mouth of Pine Creek
223L	Mouth of Toomes Creek	195R	Jenny Lind Bend
		194L	Chico Landing
		194L	Bidwell River Park

**Sacramento River Conservation Area
and
Inner River Zone Guidelines**

Reach 2 (Red Bluff Diversion to Chico Landing)





PHYSICAL SETTING

Geology and Soils

This reach is underlain by sedimentary and volcanic deposits such as the Tehama, Tuscan, and Red Bluff Formations. There are a few outcroppings of these formations within the Conservation Area. The sedimentary Tehama Formation is exposed along near vertical banks in a number of places such as Red Bluff, Tehama, Woodson Bridge and Hamilton City. More recent deposits lie on top of these older formations, including terrace deposits (including the Riverbank and Modesto Formations), paleochannel deposits, alluvial fans, meanderbelt deposits, basin and marsh deposits (DWR, 1994).

The terrace deposits of the Modesto and Riverbank flank the river in stair steps away from channel. These deposits tend to erode at a lower rate than the other young deposits and tend to form higher, more consolidated banks, along the river, referred to as geologic control (Chapter 2). Figure 4-2 illustrates the location of these deposits near Woodson Bridge.

This reach has a high proportion Class I agricultural soils, including the Columbia and Vina loams (Figure 4-3).

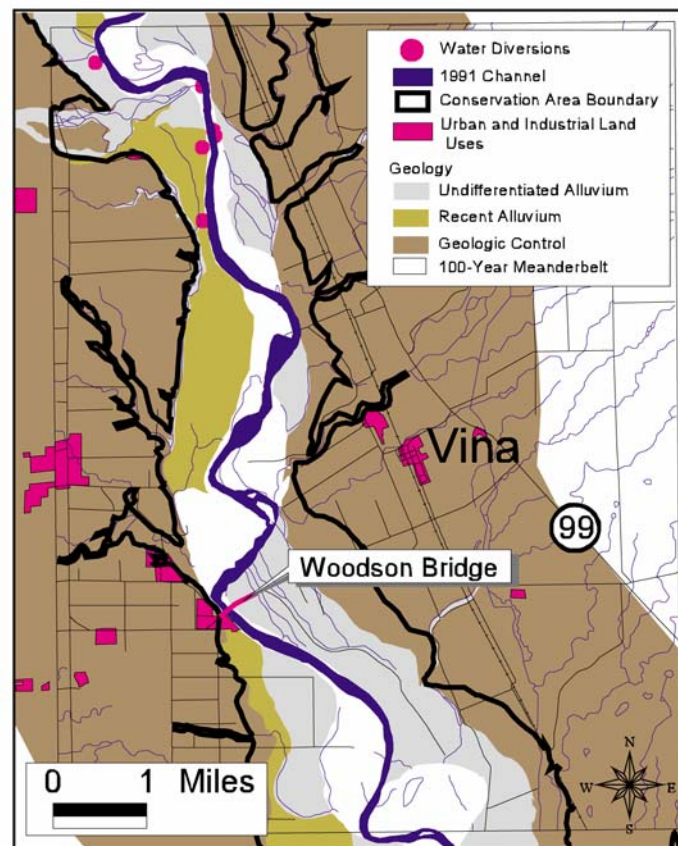


Figure 4-2. Generalized geologic units and infrastructure (bridges, water diversions, and urban and industrial land uses) along the Sacramento River, RM 214-227 (Vina Quad).

Channel Movement

The Red Bluff–Chico Landing Reach is a meandering river as described in Chapter 2. An examination of historical channel locations since 1896, as well as such features as oxbow lakes and meander scrolls, shows considerable channel movement. The combination of the channel locations between 1896 and 1991, the “one-hundred year meanderbelt,” is approximately 9,200 acres.

The current rate of channel movement in this reach would result in 4,000 to 6,000 acres of erosion and corresponding deposition over the next 50 years (DWR, 1994). New depositional areas will aggrade over time, eventually becoming high terrace lands. Half of the projected erosion will take place within the 100 year meanderbelt, indicating that the river is reworking many areas that were channel bottomless than 100 years ago.



Figure 4-3. *Sacramento River corridor near Tehama. Much of the Conservation Area contains productive agricultural areas.*

A 1994 survey of the river calculated the total bank length of this reach (including sloughs, side channels and islands) to be approximately 132 miles; the main channel bank length is approximately 92 miles (DWR, 1994). In 1994, there were 21.5 miles of bank protection installed along the river in this reach, which is currently on the main channel (USFWS, 1994). This is about 16 percent of the total channel and 23 percent of the main channel length.

The Red Bluff–Chico Landing Reach has been divided into eight subreaches (DWR, 1994), based on channel characteristics that include gradient, geometry, underlying rock types, degree of bank erosion, sinuosity, and meander belt width (Table 4-2). Within this reach, short, narrow, and straight subreaches alternate with longer, more sinuous subreaches with higher bank erosion rates. These subreaches are important in that they highlight the areas that are the most active and offer the most potential for ecosystem restoration.

Since 1945, overall channel sinuosity for this reach has decreased. This has been attributed to vegetation removal on meander bends contributing to chute cutoffs. Another possibility could be natural variability in the meander process, implying that sinuosity will increase again over time (HDR, 1993). Although 1945 was the year that Shasta Dam became operational, geomorphologists have not studied whether the altered hydrology has caused this decreased sinuosity.

Table 4-2. Geomorphic subreaches of the Sacramento River between Red Bluff and Chico Landing

River Mile	River Miles	Length (MI)	Slope	Bank Erosion	Meander Width (feet)	Sinuosity	Channel Shape
A	243-238.5	4.5	.00050	Low	1200	1.0	straight with gravel bars
B	238.5-231	7.4	.00076	High	1400-5400	1.4	sinuous, ana-branching
C	231-228.5	2.5	.00056	Low	700	1.05	straight
D	228.5-218.5	.98	.00054	High	700-5000	1.3	sinuous with gravel bars
E	218.5-216	2.5	.00030	Low	900	1.05	straight
F	216-201	13.4	.00054	High	900-5100	1.5	meandering, ana-branching
G	201-198.5	2.5	.00033	Low	800	1.05	straight
H	198.5-193	5.5	.00052	High	1300-6600	1.5	meandering

Sediment Transport

Observations made during a DWR erosion study between 1986 and 1988 indicate that erosion and deposition rates may be in balance in this reach. Although the incidence of floodplain deposition has decreased, so has the rate of bank erosion (DWR, 1994).

Hydrology and Tributaries

The hydrology of this reach has changed with the advent of the Central Valley Project as described in Chapter 2. The hydrologic influence of the tributaries is quite strong in this reach and is still able to establish and maintain a relatively healthy riparian habitat ecosystem. Each flood event is unique in terms of the quantity and timing of tributary inflow. Major tributaries include Reeds, Antelope, Mill, Elder, Thomes and Deer Creeks. The unregulated tributaries of the Keswick–Red Bluff Reach (notably Cottonwood Creek) also contribute greatly to the hydrologic characteristics and associated health of the riparian system.

The change in hydrology has altered patterns of bank erosion. Overall bank erosion rates have declined since the construction of Shasta Dam, probably due to reductions in peak flow and increased bank protection (DWR 1984, USGS 1977, USACE 1986). Sustained high releases at the dam following a large flood are often necessary to make room in Lake Shasta for runoff from a subsequent large storm. During these releases, banks are saturated and may erode more rapidly than when flows drop to pre-flood levels.

As described in Chapter 1, hydrology plays a critical role in riparian forest establishment and in the successional process. Flooding and the associated deposition create fresh damp substrate for the recruitment of cottonwood seedlings.

This process is instrumental in the formation of the point bars and terraces associated with various age classes of riparian forests and is a driving force behind the meander process.

Flooding regime alteration (Chapter 2) has probably changed the pattern of riparian forest succession in this reach, although the exact mechanisms remain unclear. One mechanism may be related to the rate of erosion and deposition. The reduction in bank erosion suggests an accompanying decrease in point bar formation. This in turn suggests that there could be fewer suitable sites for cottonwood and willow forest regeneration.

Another mechanism may be tied to the frequency with which areas along the river are subjected to flooding and the associated deposition. One result of Shasta's change to Sacramento River hydrology in the Red Bluff—Chico Landing Reach has been that smaller areas are inundated less often. For example, under today's hydrologic conditions, a 2-year flood near Red Bluff is about 70,800 cfs. Prior to the operation of Shasta Dam, a 2-year flood would have been about 110,000 cfs (TNC, 1996). In fact, since construction of the dam, the river has never reached the pre-dam 5-year flood of about 180,000 cfs (HDR, 1993). This means that a smaller area along the river is subjected to the frequency of overbank flooding required for the natural establishment, maturation, and regeneration of forests.

Land Use

About half of the Conservation Area is planted to agricultural crops (Table 4-3). The deep alluvial soils along much of the Sacramento River in this reach are ideal for growing walnuts. Almonds and prunes are also important crops.

Within the inner river zone guideline, about 4,854 acres (30 percent) of the land is in agricultural crops, mostly walnuts, almonds and prunes. A comparison of land use with the eight subreaches shows that orchards are planted most closely to the river channel along the more stable subreaches and that riparian habitat is most developed along the more unstable reaches (Figures 4-4a and 4-4b).

The towns of Gerber and Tehama are within the Conservation Area, while Hamilton City, Los Molinos, and Vina lie just outside. Scattered homes and farmsteads lie within the Conservation Area, although very little development exists within the inner river zone. Four bridges cross the river in this reach—the Southern Pacific Railroad Crossing at Tehama (R.M. 229), the Tehama Bridge (Hwy 99W) at Tehama (R.M. 229), Woodson Bridge (South Avenue) near Corning (RM 218) and Hamilton City Bridge (Hwy 32) near Hamilton City (R.M. 199).

The California Department of Fish and Game lists 29 agricultural water diversions in this reach. The two largest water diversions are the U.S. Bureau of Reclamation Tehama Colusa Canal (RM 243) and the Glenn-Colusa Irrigation District (RM 205.5).

Some of these diversions are stationary, while others are designed to be mobile. All but nine appear to be located on or near geologic control.

There are a number of recreational sites along this reach of the river. These sites include boat launch areas, fishing and swimming areas, and RV parks. The California Department of Parks and Recreation owns three state park areas along the river.

Table 4-3. *Land Use within the Conservation Area, Red Bluff—Chico Landing Reach*

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	4,854	30%	18,300	53%
Riparian Vegetation	5,662*	35%*	6,864	20%
Upland Vegetation	2,973*	18%*	5,250	15%
Water Surface (excluding main channel)	696	4%	695	2%
Miscellaneous (includes barren wasteland)	1,787	11%	1,932	6%
Urban	321	2%	1,301	4%
Total Land Surface Area	16,293	100%	34,107	100%
Channel Surface Area	2,896		2,896	
Total	19,189		37,238	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for the most accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References).

RIPARIAN VEGETATION

Current Acreage

The survey of riparian resources within this reach is based on 1999 photos; aerial interpretation was performed by the Geographic Information Center at California State University, Chico. The Sacramento River corridor, as defined by the 100-year floodline and contiguous stands of valley oak woodlands, contains more than 9,000 acres of riparian vegetation. Extensive and significant stands of remnant riparian forest are associated with sinuous subreaches (Figure 4-4b) and provide habitat for a variety of sensitive wildlife species including osprey, Swainson's hawk, western yellow billed cuckoo, bank swallow, yellow warbler, yellow breasted chat and northwestern pond turtle.

Table 4-4 lists acreage of riparian vegetation types and other closely related habitats for the area within the inner river zone guideline. The relative amount of total riparian habitat to other land use categories decreases with distance from the active channel.

Approximately 28 acres of valley oak woodland occur outside of but adjacent to the 100-year floodplain. Most of the valley oak woodlands for this reach are found outside of the inner river zone, but within the area inundated by a flood with a 2.5 year recurrence interval.

Table 4-4. *Riparian and closely related habitats within the, inner river zone guideline, Red Bluff—Chico Landing Reach*

VEGETATION TYPE	*INNER RIVER ZONE GUIDELINE		*CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	4,417	27%	5154	10%
Riparian Scrub	3,630	22%	3929	7%
Valley Oak Woodland	44	<1%	115	<1%
Marsh	97	<1%	141	<1%
Blackberry Scrub	13	<1%	46	<1%
Total Riparian Vegetation	8,201	50%	9385	28%
Total Land Surface Area	15,904		34,107	
Channel Surface Area	2,896		2,896	
Total	18,800		37,003	

**(The outer boundary of the Conservation Area in Shasta and Tehama Counties is the approximate 100 year designated floodplain; beginning at the southern Tehama County line, the boundary of the Conservation Area is the same as the Inner River Zone). See Page I-5 for further explanation. GIC (1997; 2000). Percentages may not total due to rounding.*

Current Extent of Habitat Types at Water's Edge

There are several types of banks and habitat types along the river in this reach, including shaded riverine aquatic habitat, cut banks, and sand and gravel bars. Banks in this reach have been recently surveyed by the U.S. Fish and Wildlife Service (USFWS) and the Department of Water Resources (USFWS, 1990; DWR, 1994).

Bank Swallow Nesting Habitat

The USFWS surveyed this reach for bank swallow nesting habitat in 1989, finding .98 miles of active bank swallow nesting habitat and 4.98 miles of inactive habitat. Active sites had bank swallow burrows. Inactive sites did not have burrows, but had the suitable slope, bank height and soil erodibility. In 1994, DWR measured 5.39 miles of suitable bank swallow nesting banks, including both active and inactive sites (Appendix D).

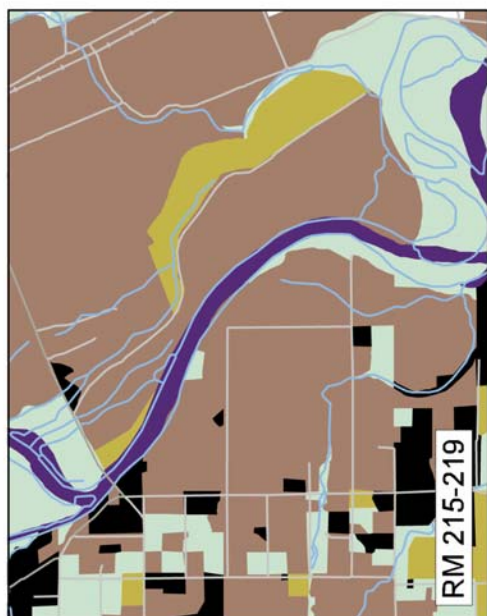


Figure 4-4a. A comparison of land use patterns between an active subreach (left) and a more stable subreach (right). Dark brown areas represent orchards.

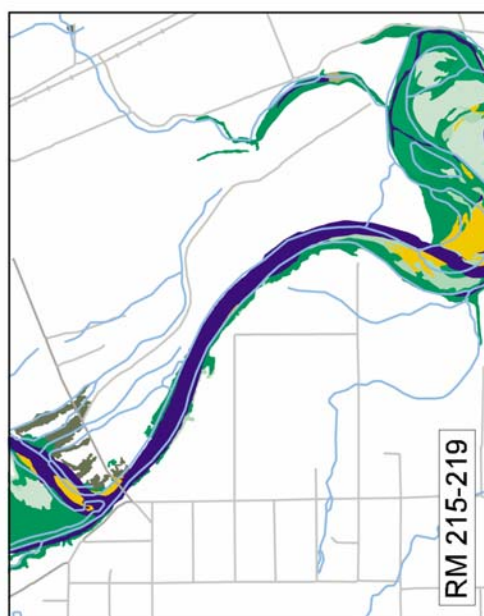


Figure 4-4b. A comparison of riparian vegetation patterns between an active subreach (left) and a more stable subreach (right). Green areas represent successional stages of riparian forest.

The DWR figure represents six percent of the main channel bank length (bank swallow nesting habitat is on the active channel) or four percent of the total channel length.

Shaded Riverine Aquatic Habitat

In 1996 DWR measured 47.41 miles of shaded riverine aquatic habitat in this reach (36 percent of total bank length). Depositional areas accounted for 47.84 miles of bank length (36 percent).

Ownership

Most of the publicly owned land lies within the flood—and erosion—prone lands within the inner river zone guideline (Table 4-5). Some of the publicly owned land that is in agriculture is being converted to riparian habitat, while other portions are leased to agricultural operators to fund restoration efforts (Chapter 7). Private ownership encompasses many land uses including homes, recreational facilities, buildings, pumping plants, flood control structures, agricultural lands, and lands with various types of vegetation.

Table 4-5 *Ownership, Red Bluff—Chico Landing Reach*

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	9,458	59%	25,309	74%
Public				
Federal	3,429	22%	5,327	16%
State	2,759	17%	3,201	9%
Local District, City, County	258	2%	270	1%
Total (Land Surface Area):	15,904	100%	34,107	100%
Channel Surface Area	2,896		2,896	
Total	18,800		37,003	

DWR Sacramento River GIS (May 2000); DPR (1994). Rounded to nearest 100 acres.

Restoration Strategy

All restoration:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

Inner River Zone Guideline

The inner river zone guideline within Reach 2 consists of the area of the 100-year meanderbelt combined with the 50-year erosion projection. When combined, they cover a land surface area of 15,900 acres (Table 4-6). This guideline should be used to focus restoration efforts, and projects should be evaluated according to the established restoration priorities:

1. Preserve intact processes

As the most erosion- and flood-prone land along the river, the Red Bluff–Chico Landing Reach has the greatest potential for the re-establishment of a functional riparian ecosystem. *Protection of land within the inner river zone guidelines, either through landowner participation in voluntary programs or through purchase of these properties or easements by the proposed nonprofit management entity or cooperating public agencies, should receive top priority.*

In the Red Bluff to Chico Landing Reach a 2.5 year interval flood event is associated with inundation of more than 57 percent of the Conservation Area. For some localities, flooding occurs outside of the inner river zone guideline (Figure 4-6). Flood frequency at the 2.5 year recurrence could permit the natural regeneration of riparian forest if the timing of other factors such as seed dispersal, and temperature regime are favorable. Monitoring programs within frequently flooded fallow fields should indicate if this method of “natural restoration” is feasible on a large scale.

Table 4-6. Comparison of areas within the inner river zone guideline, area inundated in a 2.5 year flood, and Conservation Area, Red Bluff to Chico Landing Reach

	INNER RIVER ZONE GUIDELINE* (acres)	AREA INUNDATED BY 2.5 YEAR FLOOD,¹ (acres)	CONSERVATION AREA (acres)
Land Surface	15,900	19,400	34,107
Channel Surface Area	2,896	2,896	2,896
Total Area	18,700	22,296	37,003

*Refer to Figure 2-12. Acreage rounded to nearest 100 acres

¹Estimates based on photography of the Sacramento River at a stage approximating a 2.5 year flood.

2. Allow riparian forests to reach maturity

There are extensive areas of early successional stages, identified as riparian scrub in Table 4--4, within the inner river zone guideline. These would be allowed to undergo natural succession to a mature forest under inner zone management. Almost 1,800 acres of “herbland” (a cover type of annual and perennial grasses and forbs) also occurs within the inner river zone guideline. *These areas are suitable for establishment of early successional stages and should be allowed to reach maturity under inner zone management.*

A significant amount of riparian scrub and herbland occurs outside of the inner river zone guideline but within the 2.5 year flood line. These areas may not follow a “typical” successional process but should be allowed to reach a climax forest.

3. Restore physical and successional processes

As described in the previous chapter, the re-establishment of suitable hydrologic regimes through relocation of berms to higher elevations and the use of regulated flows during seed dispersal of early successional species would facilitate the establishment of riparian species. The majority of the riprap for this reach is in place to prevent the meandering process. Where such bank revetment is no longer needed its removal would restore natural processes and riparian habitat. Any such removal, however, would have to be consistent with the principles outlined at the beginning of this chapter.

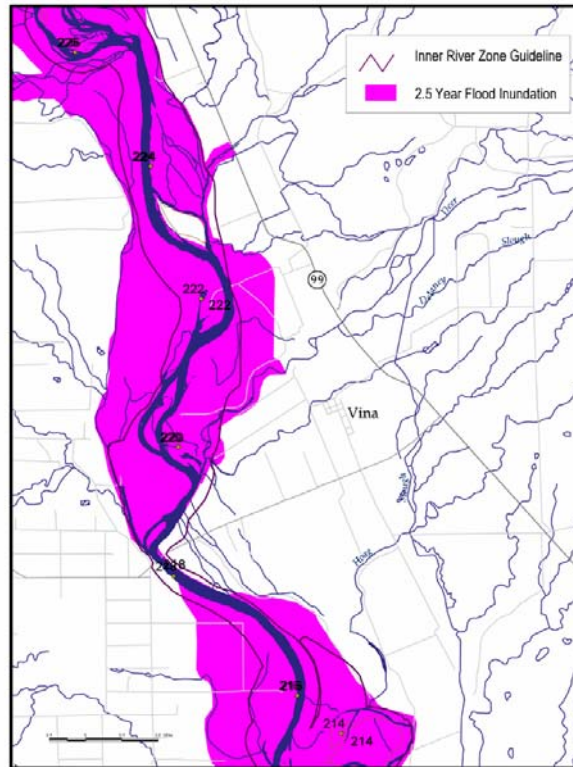


Figure 4-6. Comparison of inner river zone guideline with area inundated in a 2.5 year flood.

4. Conduct reforestation activities

Areas outside the frequently flooded areas (defined here as a 2.5 year interval occurrence), but within the Conservation Area, may need active riparian vegetation restoration activities. Because of the lack of a flooding regime on these areas it would be inefficient to attempt to establish early successional or other species which would need a permanent artificial water source. Establishment of valley oak woodland and elderberry savanna (possible valley elderberry long-horn beetle mitigation preserves) is recommended for such areas, because these species are able to withstand drought conditions and perhaps tap into deep water tables. *The establishment of a wide continuous riparian and valley oak woodland corridor should be the first option under the reforestation priority.* Areas adjacent to the corridor should be considered for active restoration after a continuous corridor is established.

The use of “natural restoration” (priority #1) may involve the control of invasive or weedy species. As previously mentioned, establishing a monitoring program within the 2.5 year interval area would help define possible guidelines for the natural restoration within this reach. If native vegetation is out competed by invasive species such as Johnsongrass, star thistle, giant reed, and tree of heaven, a mechanical/herbicide control program or active revegetation plan may be necessary.

Chico Landing-Colusa Reach

Significant remnants of riparian forest remain between Chico Landing and Colusa. Their pattern upon the landscape reflects the meander scrolls left by former channels of the river.

This reach of the river marks the beginning of historical overflow into the Butte and Colusa Basins and the gradual downstream development of natural levees. It is also the beginning of the Sacramento River Flood Control Project, which controls and directs overflows into the Sutter Bypass through a system of setback levees, overflow areas, and weirs.

This reach extends from Chico Landing at the mouth of Big Chico Creek, past the Ord Ferry Bridge, the tiny towns of Ord, Glenn, and Butte City, and the Butte City Bridge. Downstream of Princeton and the Princeton Ferry, floodwaters are diverted out of the setback levee system into Butte Basin through the Moulton Weir. Just north of Colusa, the Colusa Weir diverts additional floodwater. The reach ends at Colusa Bridge in the City of Colusa (Figure 5-1 and Table 5-1).

In its *1989 Plan*, the SB1086 Advisory Council recommended establishing a Conservation Area along the Sacramento River. In 2002, the boundary of the Conservation Area was determined to be the same as the inner river zone guideline within this reach. The Conservation Area defines the location where interested landowners may participate in voluntary riparian habitat programs administered or coordinated through the Sacramento River Conservation Area. The purpose of the Inner River Zone is to focus the preservation and reestablishment of a continuous riparian ecosystem on the erosion and flood-prone areas along the Sacramento River in a manner that follows the six guiding principles:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

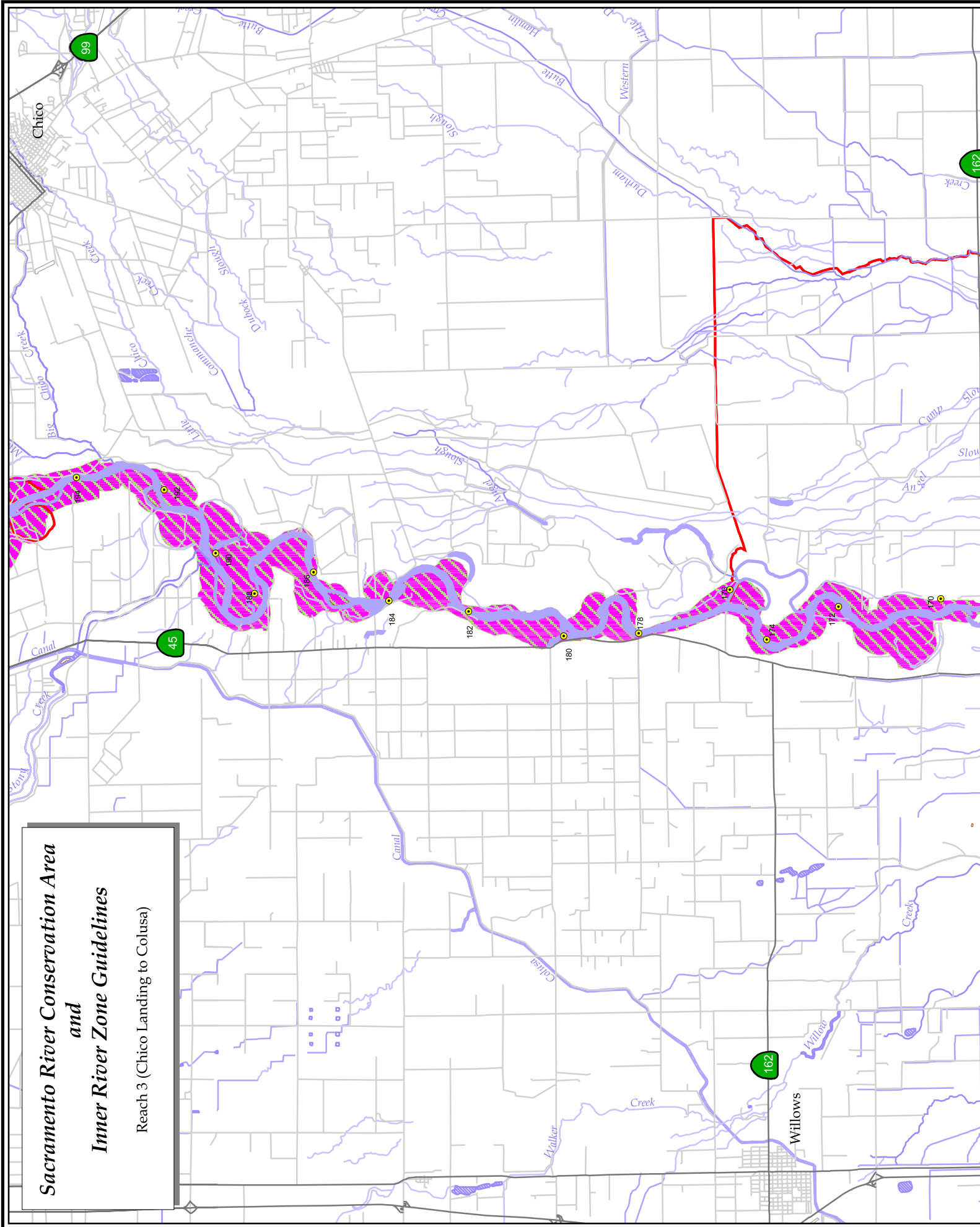
Table 5-1. *Features of the Chico Landing—Colusa Reach*

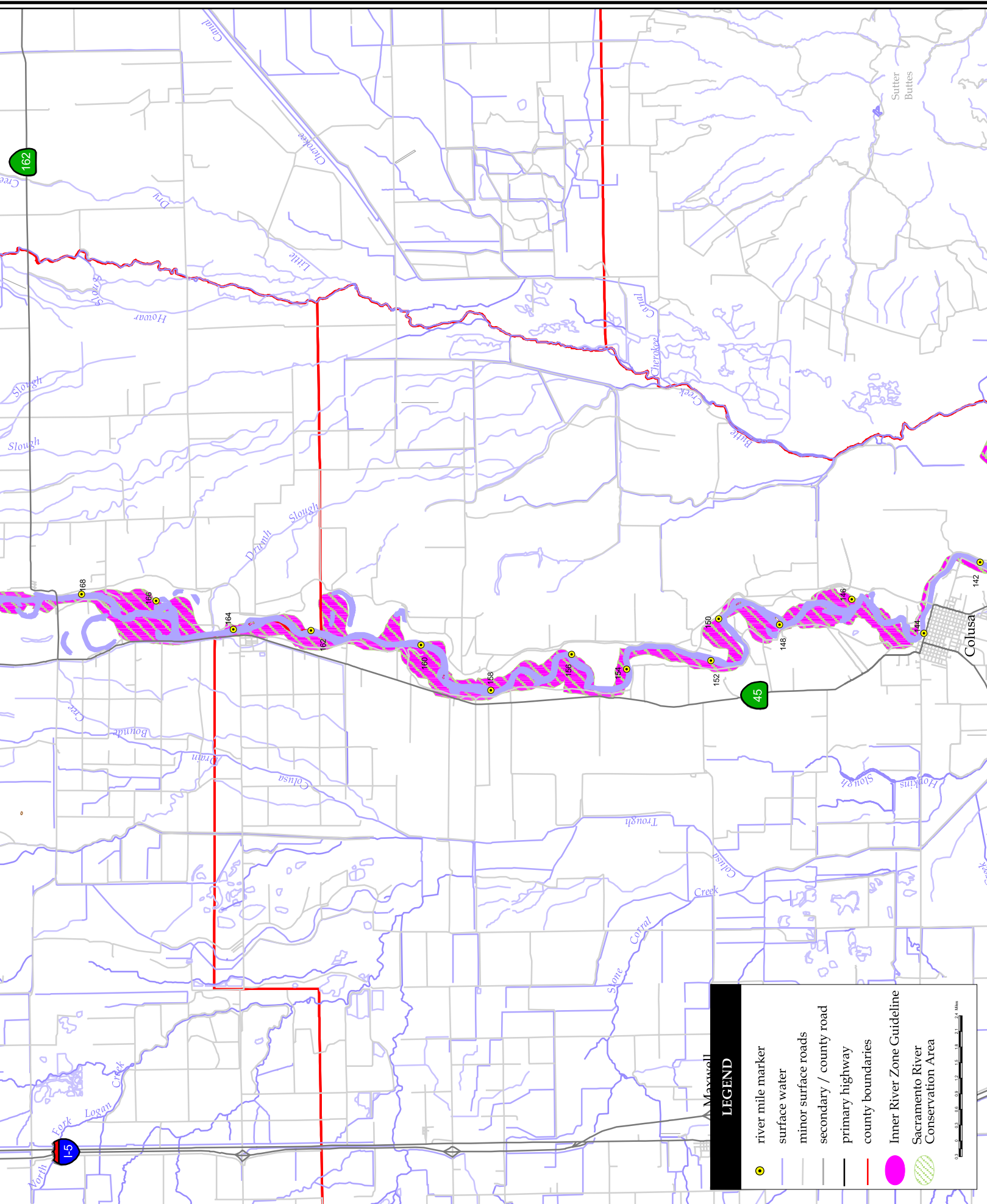
RIVER MILE	FEATURE	RIVER MILE	FEATURE
194L	Chico Landing	169R	Mouth of Razor Slough
194L	Mud Creek	169L	Butte City
193L	Mouth of Big Chico Creek	169R	Codora
193L	Bidwell River Park	167R	Packer Island
191R	Phelan Island	167R	Packer Lake
190R	Mouth of Stony Creek	164R	Princeton
190L	Mouth of Murphy Slough	164	Princeton Ferry
190L	Golden State Island	161L	Boggs Bend
184	Ord Ferry Bridge	160R	Stegeman
184	Ord Ferry Road	159L	Moulton Weir
184R	Ordbend	151L	Hamilton Bend
182L	The Lagoon	146L	Colusa Weir
181L	Perkins Lake	146L	Mouth of Colusa Bypass
180R	Jacinto	145R	Colusa Sacramento River State Recreation Area
178R	Mouth of Provident Irrigation Main Canal	144R	Colusa
176L	Eddy Lake	143	River Road
173L	Hartley Island		
171R	Hanson Island		

The inner river zone in this reach includes those areas along the river where aerial photography shows evidence of meander. That should be the focus of efforts to preserve and restore river processes. By nature, the channel alignment in this area is transitory and subject to change. The criteria used to develop a guideline for the inner river zone include historical and projected future erosion (Chapter 2). The inner river zone guideline within Reach 3 consists of the 100-year meanderbelt combined with 50-year erosion projections, and does not compromise the structural integrity of the existing state or federally authorized flood control levees and structures or conflict with the operation and maintenance jurisdiction of local maintaining entities as designated by The Reclamation Board. The inner river zone does not include the weir or by-pass areas.

***Sacramento River Conservation Area
and
Inner River Zone Guidelines***

Reach 3 (Chico Landing to Colusa)





Chico Landing – Colusa Reach

River, floodwaters are released eastward into the Sutter Bypass through Moulton, Colusa, and Tisdale Weirs.

The setback levees of the Sacramento River Flood Control Project are generally built along the Modesto Formation along the west side of the river. On the east side, however, the levees lie well within the paleochannel deposits. There are meander scars visible outside of the levees just north of the Colusa Weir. A strip of natural levee deposits lies outside of the east side project levee for most of the reach.

The Reclamation Board is responsible for maintenance of the Sacramento River Flood Control Project, as well as the Sacramento River Bank Protection Project. The responsibility is passed on to the local reclamation and levee districts, or to the California Department of Water Resources where no such district exists. The bank protection project consists of the rock revetment of about 160 miles of banks and levees, installed to ensure the security of the flood control system.

Channel Movement

The Chico Landing–Colusa Reach is a meandering river (Chapter 2). The combination of channel locations between 1896 and 1991, the “one-hundred year meanderbelt,” is approximately 9,200 acres. As in the Red Bluff–Chico Landing Reach, relatively stable, straight subreaches alternate with more sinuous, dynamic subreaches.

This reach of the river has become less sinuous since 1896. This has been attributed to chute cutoffs promoted by the clearing of riparian forests and to natural variation over time (USGS, 1977; WET 1988). Two meander scars of unknown age (Eddy Lake, R.M. 176-177, and a meander scar at R.M. 167-168) indicate a high degree of sinuosity in at least portions of the channel in the recent past.

The subreach just upstream of the setback levees where floodwater flows away from the main channel through the flood relief structures is referred to as the Butte Basin Reach (RM 176-194). The USACE has been stabilizing the channel in this reach with a series of bank protection installations, as part of its flood control responsibilities. Because changes in channel alignment in the Butte Basin Reach (particularly chute cut-offs of meander loops) could lower channel elevation, it was thought that this would result in less flow into Butte Sink via the flood relief structures, and more flow down the leveed river corridor. Too much water flowing down the leveed river corridor could compromise the effectiveness of the flood control system. Recent studies indicate however, that change in channel elevation is insignificant in altering the flow split between Butte Basin and the main channel of the Sacramento River at higher flows. These studies show that excessive flows are entering the leveed reach regardless of channel alignment (Ayres, 1997).

Land Use

Approximately 16% (about 1,946 acres) of the Conservation Area is used for agriculture (Table 5-2). Important crops include walnuts, prunes, wheat, almonds, and beans.

There are several towns along this reach of the river, including Glenn, Princeton, Butte City and Ord Ferry. Two bridges cross the river in this reach; the Ord Ferry Bridge, (R.M. 184), and the Butte City Bridge, (R.M. 168). The Princeton Ferry is at River Mile 164.

Table 5-2. *Land use within the Conservation Area, Chico Landing—Colusa Reach*

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	1,946	16%	1,946	16%
Riparian Vegetation	5,944	48%	5,944	48%
Upland Vegetation	1,374	11%	1,374	11%
Water Surface (excluding main channel)	275	2%	275	2%
Urban	1,371	11%	1,371	11%
Miscellaneous (includes barren wasteland)	1,583	13%	1,583	13%
Total Land Surface Area	12,493	101%	12,493	101%
Channel Surface Area	2,832		2,832	
Total	15,325		15,325	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for more accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding.

The Princeton-Codora Glenn Irrigation District, Roberts Ditch Irrigation Company and Reclamation District 2047 lie partially within the Conservation Area. The California Department of Fish and Game recorded 95 agricultural diversions along this reach of the river, ranging from small, portable units owned by private landowners to large plants providing water to large irrigation districts. Irrigation districts pumping water within this reach include Maxwell Irrigation District, R.D. 1004, Princeton-Codora-Glenn Irrigation District, and the Provident Irrigation District.

The California Department of Parks and Recreation lists approximately ten recreation sites along this reach of the river, including boat landings, day use areas, and a wildlife area and a scenic park.

RIPARIAN VEGETATION

Current Acreage

The summary of riparian and associated vegetation types within the Inner River Zone Guidelines and Conservation Area (Table 5-3) is based on Geographic Information Center, California State University Chico 1999 riparian habitat mapping. While the project mapped most riparian habitat along the Sacramento River, it did not map the entire Conservation Area. The actual amount of riparian habitat within the Conservation Area may be somewhat higher. The Geographic Information Center at CSU, Chico is currently updating riparian habitat acreages based on recent aerial photographs.

Table 5-3. *Riparian and other native vegetation types and closely related classifications within the Conservation Area*

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	4,621	42%	4,621	42%
Riparian Scrub	3,276	30%	3,276	30%
Valley Oak Woodland	20	<1%	20	<1%
Marsh	83	<1%	83	<1%
Blackberry Scrub	11	<1%	11	<1%
Total Riparian Vegetation	8,011	72%	8,011	72%
Total Land Surface Area	11,072		11,072	
Channel Surface Area	2,832		2,832	
Total	13,904		13,904	

GIC (1997; 2000). Percentages may not total due to rounding.

This reach is particularly rich in freshwater marsh habitat. These marshes are often associated with oxbow sloughs outside of the 100-year meander belt. An excellent example of this vegetation type is found at Murphy Slough (Figure 5-2). Sensitive species, such as rose mallow (California hibiscus) and pond turtles, are located in these areas of still or slowly moving waters. The Conservation Area also contains more than 1,000 acres of seasonal wetlands (most of which is managed waterfowl habitat) (DWR Butte 1994; Glenn 1993).

**Figure 5-2.** *Murphy Slough*

Excellent examples of mature riparian habitat, which supports federally or state listed species. Such as Swainson's hawk and western yellow billed cuckoo, are also found within this reach. DFG has identified several valley elderberry longhorn bee-

tle (VELB) sites between RM 169 and 180 (CDFG, 1996). The beetle's host plant, blue elderberry, can be found in a wide variety of vegetation types including mature riparian forest and open elderberry savannas on higher terraces along the river.

Current Extent of Habitat Types at the Water's Edge

The total bank length for this reach of the river, (including sloughs, side channels and islands), is approximately 133 miles (USACE, 1991). The main channel (excluding sloughs, side channels and islands) has a bank length of approximately 105 miles. There are several types of banks and habitat types, including shaded riverine aquatic habitat, cut banks, sand and gravel bars, and revetted banks (Appendix D).

Bank Swallow Nesting Habitat

The U.S. Fish and Wildlife Service(USFWS) surveyed the river for bank swallow nesting habitat in 1989 (USFWS, 1990). Biologists measured 2.01 miles of active habitat, and 8.97 miles of inactive habitat. Active sites had bank swallow burrows. Inactive sites did not have burrows, but had the suitable slope, bank height, and soil erodability. The total bank swallow habitat for this reach represents 8 percent of the total bank length and 10 percent of the main channel.

Shaded Riverine Aquatic Habitat

USFWS biologists measured 22.20 miles of shaded riverine aquatic habitat along the Chico Landing-Colusa Reach in 1991. This represents 17 percent of the total channel bank length.

Ownership

Approximately 67 percent (7,437 acres) of the Conservation Area is owned privately. Publicly owned parcels encompass approximately 32 percent (3,634 acres) of the area and are largely concentrated close to the main channel of the river. Table 5-4 shows the proportion of publicly held land within the Conservation Area.

The publicly owned land includes several units of the federal Sacramento River National Wildlife Refuge. State publicly owned land includes lands held by the California Department of Fish and Game (DFG) as part of the Sacramento River Wildlife Area, lands held by the State Lands Commission, and approximately 400 acres purchased by the Reclamation Board to preserve riparian vegetation and preserve stability of the river. These purchases include MBK sites (Chapter 7).

There are also approximately 19 conservation easements on private land in this reach encompassing 3,600 acres. These easements range greatly in size. Some are small areas between the waterside levee toe and the river on the waterside berm, purchased from willing sellers to mitigate for the second phase of the Sacramento River Bank Protection Project. The Reclamation Board holds these easements and DWR manages them. The Nature Conservancy and the USFWS hold the two largest easements, at Llano Seco, owned by Parrot Investment Company, Inc. (near R.M. 176-183, right bank). DFG also administers conservation easements in this reach (Chapter 7).

Table 5-4. *Ownership within the Conservation Area, Chico Landing–Colusa Reach*

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	7,437	67%	7,437	67%
Public				
Federal	1,092	10%	1,092	10%
State	2,523	23%	2,523	23%
Local District, City, County	20	<1%	20	<1%
Total (Land Surface Area):	11,072	100%	11,072	100%
Channel Surface Area	2,832		2,832	
Total	13,904		13,904	

DWR Sacramento River GIS(May 2000); DPR (1994).

Restoration Strategy

All restoration shall use the six guiding principles:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

Inner River Zone Guideline

The inner river zone guideline within Reach 3 consists of the area of the 100-year meanderbelt combined with 50-year erosion projections, and does not compromise the structural integrity of the existing state or federally authorized flood control levees and structures or conflict with the operation and maintenance jurisdiction of local maintaining entities as designated by The Reclamation Board. The inner river zone guideline does not include the weir or by-pass areas.

The reach between Chico Landing and Colusa is divided into two distinct subreaches depending on the presence of flood control setback levees. The opportunities for restoration efforts will differ somewhat between these two reaches.

1. Preserve intact processes

The area between R.M. 176 and 144 is enclosed by setback levees, and encompasses the 100-year meanderbelt. Active river meander and associated successional riparian types are present in a number of sites within this portion of the reach. Virtually all of the soils between these levees are floodplain deposits. *Purchase of these areas or landowner participation in voluntary programs within erosion—and flood-prone areas, should receive the highest priority for the protection of a functional riparian ecosystem.* The majority of the setback levee reach is inundated by a 2 year flood event. Virtually 100 percent of that reach is inundated by a 4 year flood event (Figure 5-3). Plans have begun to monitor for “natural restoration” within a fallow orchard, within the northern portion of this reach which is flooded by a 2.5 year flood event. Monitoring of a similar 2 year and the 4 year event, sites within the lower reach would also be useful in guiding restoration efforts.

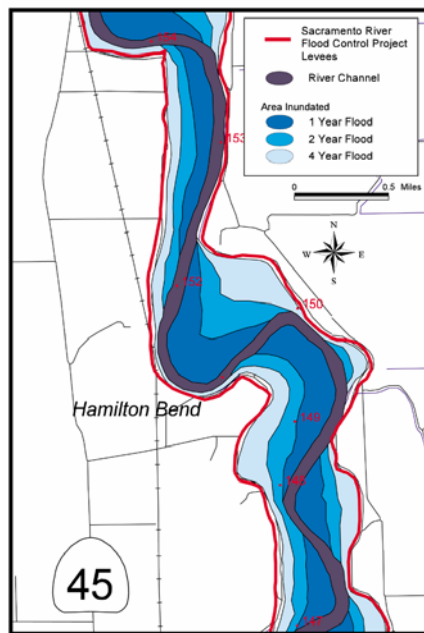


Figure 5-3. Areas inundated at various flood recurrence intervals within the Sacramento River Flood Control Project setback levees

2. Allow riparian forests to reach maturity

According to the 1987 DWR data, the 9,086 acres of riparian habitat present were dominated by large climax vegetation (3,992 acres). Early successional stages were also well represented (2,259 acres). *All areas of early successional stages should be allowed to mature to climax conditions, thus ensuring a wide variety of vegetation types.* Areas outside of active meander belts but within “natural restoration” areas should also be allowed to reach mature states.

3. Restore physical and successional processes

As previously discussed, channel movement above the setback levees (Butte Basin Reach) is limited by bank protection. If current studies by the USACE indicate that channel movement has no significant effect on riverbed levels, this portion of the river should be reviewed for restoration of physical processes. The river meander is restricted to the 100 year meanderbelt for the majority of the setback levee reach. Recent floodplain deposits, evidence of meanders older than the 100-year meander, as well as deposits that no longer show evidence of meander (due to changes with time or agricultural development) are present outside of the setback levees area (DWR, 1994).

4. Conduct reforestation activities

Areas outside of the levees in the setback reach, outside the frequently flooded areas (defined here as a 2.5 years interval occurrence), or in the areas above R.M. 176 which are “cut-off” from meandering or flooding, require active restoration. Because of the lack of a flooding regime on these areas, it would be inefficient to attempt to establish early successional or other species which would need a permanent artificial water source. Establishment of valley oak woodlands and elderberry savanna (possible valley elderberry longhorn beetle mitigation preserves) is recommended for such areas, because these species are able to withstand drought conditions. The exception would be areas of seepage adjacent to levees which may support wetland vegetation. *The establishment of a wide continuous riparian and valley oak woodland corridor should be the first option under the reforestation priority. Areas adjacent to the corridor should be considered for active restoration after a continuous corridor is established.*

The use of “natural restoration” may involve the control of invasive or weedy species. As previously mentioned, the establishment of monitoring programs within the frequently flooded areas will help define possible guidelines for the natural restoration within this reach. If native vegetation is out-competed by invasive species a mechanical/herbicide control program or active restoration plan may be necessary. Reforestation activities are restricted, or severely limited, in areas designated for flood-water over-flow. Larger trees with no understory, may be allowed to remain in the floodways, but because these are designated floodways, dense low growing vegetation is routinely treated with herbicide or removed by maintenance personnel.

Colusa-Verona Reach

The character of the Sacramento River changes considerably near Colusa. This was as true before the completion of the Sacramento Valley Flood Control Project as it is today.

Downstream of Colusa the gradient of the river decreases, the channel becomes narrower and deeper, its capacity smaller, and its bed material finer. The natural levees, discontinuous further north, are now continuous along both sides of the channel to its confluence with the Feather River. These levees are not pronounced, but are broad surfaces that slope gradually away from the river.

In its *1989 Plan*, the SB1086 Advisory Council recommended establishing a Conservation Area along the Sacramento River. The Conservation Area in reach 4 is contiguous with an inner river zone that defines the locations where interested landowners may participate in voluntary riparian habitat programs administered or coordinated through the Sacramento River Conservation Area Forum. Inner river zone guidelines for this reach have been developed (Chapter 2, pages 2-24 through 2-28), and should be incorporated into site specific planning. The purpose of the inner river zone is to focus the preservation and reestablishment of a continuous riparian ecosystem on erosion and flood-prone areas along the Sacramento River in a manner that follows the six guiding principles:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

The Conservation Area for this reach is centered on the river's main channel of an area from Colusa to the confluence with the Feather River at Verona. Although the natural levees and associated loamy soils extend up to 15 miles beyond the main channel of the river, the Conservation Area only includes those areas within the levees.

PHYSICAL SETTING

Soils

The natural levees generally consist of floodplain materials deposited over clays. They tend to be composed of loams and sandy loams, with some silt loams and clay loams. The levee soils tend to be well-drained, although some have a high water table. Typical soils series along these levees are the Colombia and Sycamore soils, which are often planted in orchards. Closest to the river these floodplain loams are deepest, becoming shallower with distance. Before the advent of the flood control project, these natural levees were about 5-20' higher than the flood basins on either side of the river. They range in width from one to ten miles. Prior to reclamation, the natural levees formed corridors of relatively dry land up either side of the river channel as the basins on either sides turned in to vast marshlands during the fall, winter, and spring.

Historically, these “natural levees” also formed along the sloughs that drained floodwater into the basins, as well as along the river channel itself. The Knights Landing Ridge, for example, which separates Yolo and Colusa Basins, is the pair of natural levees alongside the historical course of Cache Creek. The location of some of these former sloughs can be seen in the pattern of alluvial soils in the valley.

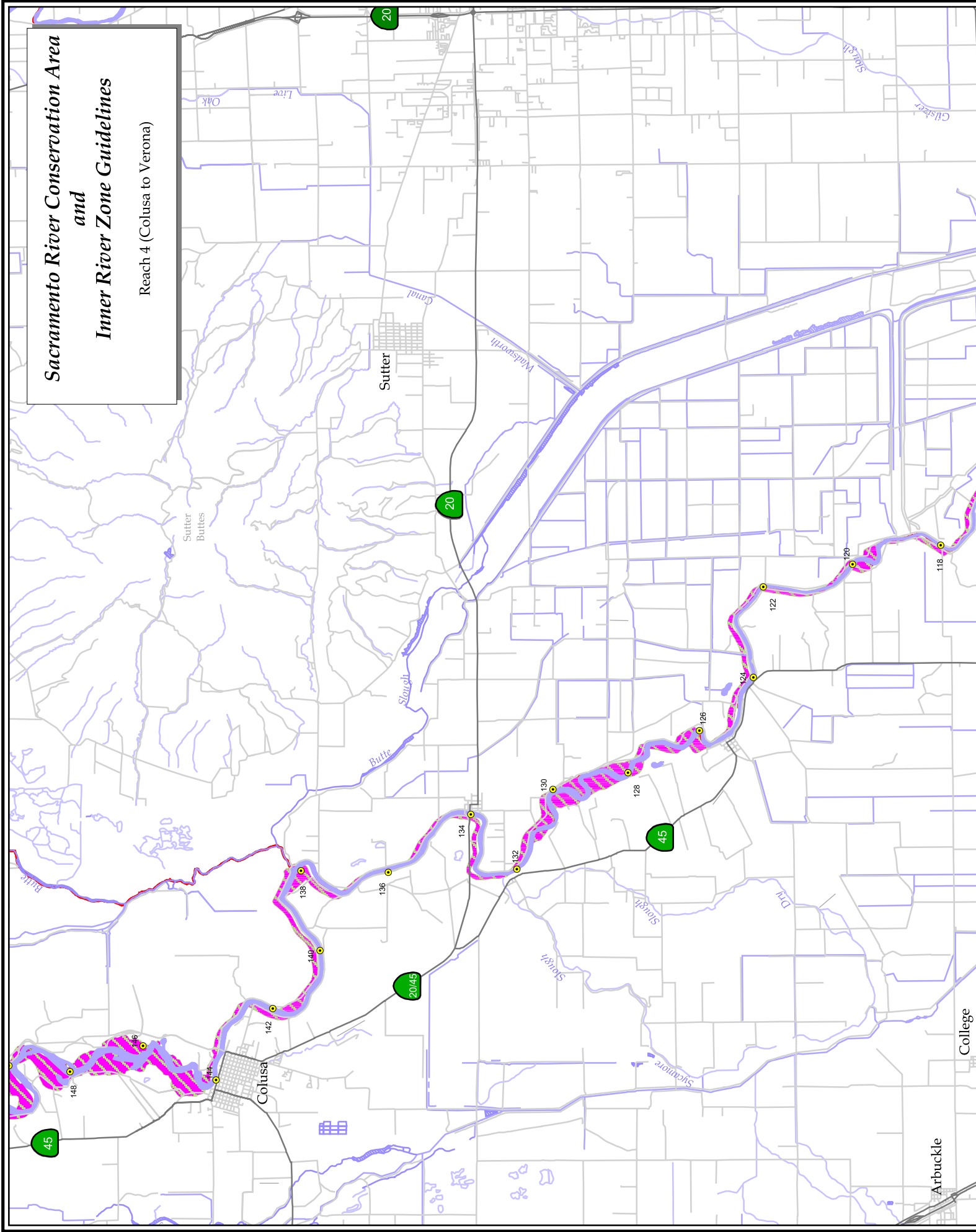
Because the natural levees prevented some tributary streams (such as Butte Creek) from joining the main river, particularly during lower flows, they would drain to the basins into “an intricate plexus of sloughs which meander through the tule-land bordering the main river” (Thompson, 1961). Prior to reclamation, runoff from surrounding areas tended to concentrate in Butte, Colusa, Sutter, and Yolo Basins.

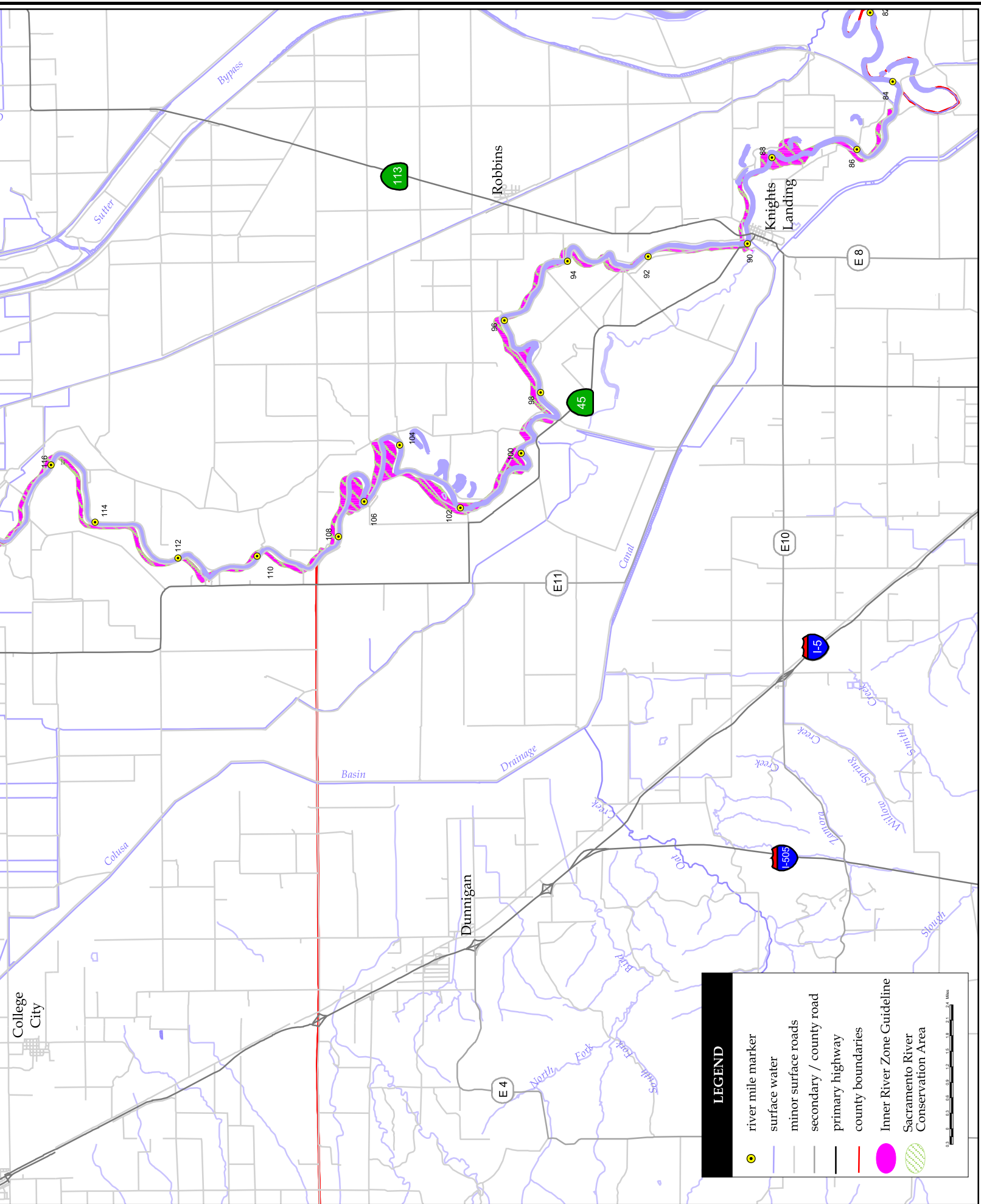
Table 6-1. Features of the Colusa–Verona Reach

RIVER MILE	FEATURE	RIVER MILE	FEATURE
143	Colusa Bridge	104R	China Bend
141L	Butte Slough	103L	Collins Eddy
138L	Butte Slough Outfall Gates	102R	Tyndall Landing
137L	Woods Lake	102L	Mystic Lake
134L	Meridian	102L	Horseshoe Lake
132R	Former mouth of Sycamore Slough	102R	Beaver Lake
127R	Cecil Lake	99L	Eldorado Bend
125L	Sills Lake	97L	Missouri Bend
125R	Grimes	94L	Sutter Recreation Area
119L	Tisdale Weir	90R	Knights Landing Outfall Structure
119L	Mouth of Tisdale Bypass	90R	Mouth of Colusa Canal Basin Drainage
118R	Mouth of Wilkins Slough	90R	Knights Landing
116R	Steiner Bend	88R	Portuguese Bend
115L	Cranmore	87L	Mary Lake
112R	Millers Landing	86L	Horseshoe Lake
111L	Boyers Bend	82R	Fremont Weir
105L	Kirkville	80L	Mouth of Sacramento Slough
104L	Hiatt Lake	80L	Mouth of Feather River
		80L	Verona

Sacramento River Conservation Area and Inner River Zone Guidelines

Reach 4 (Colusa to Verona)





Historical Channel Movement

The landscape shows evidence of historical meandering in this reach. This tendency is strongest in three areas: RM 126-130 near Grimes, RM 96-107 near Kirkville, and RM 81-89 near Knights Landing. This meandering has been linked to the presence of major distributaries along the pre-reclamation river. As a distributary channel drained off floodflows, the remaining water in the channel has less energy and drops some of its sediment load. In theory, this deposition will cause the channel to become more sinuous. At the area near Knights Landing, it is surmised that Cache Creek (which historically entered the river near the Knights Landing Outfall Structure) contributed much sediment but relatively little flow, resulting in the same effect (Priestaf, 1983). Another factor that has affected the sinuosity is that some portions of the channel were probably straightened as an aid to navigation.

The meander process probably occurred more slowly in this reach. The gradient of the river is lower than upstream and the size of the sediment is finer. This means the erosion rates were probably lower. Therefore, the mosaic of riparian habitat types may have been considerably different than upstream.

Estimates of the historical extent of riparian vegetation in this reach have relied on historical soil surveys. More than 100,000 acres of alluvial soils probably supported both riparian plant communities and valley oak woodland. Cottonwood, willow and other riparian species grew where there was a sufficiently high water table, such as along the channel itself, in the shallower loams at the basin margins, and along the networks of sloughs and tributaries. The highest portions of the natural levees, corresponding with the deepest alluvial soils probably supported valley oak woodland.

Flood Control and Reclamation

Reclamation districts in this reach were formed as early as the 1870s. The early attempts at reclaiming the flood-prone lands alongside the river consisted of closing off sloughs and building low levees along the main channel. These efforts were not coordinated, levees on the east side would force more floodwater to the west, and vice versa. Likewise, the damming of overflow into sloughs no doubt had consequences downstream. Problems in this reach were compounded by massive volumes of hydraulic mining debris moving down the Feather River, creating an underwater dam, backing up flood flows as far north as Colusa.

After many years, a federal and state cooperative effort, the Sacramento Valley Flood Control Project, replaced this uncoordinated effort at flood control. The project consists of a system of levees, overflow weirs, outfall gates, pumping plants, bypass floodways, and overbank floodway areas. Much of the project design was based on the fact that the magnitude of Sacramento River floods far exceed main channel's capacity. The floodwater which once flowed into the basins through a myriad of sloughs is now diverted into Colusa, Moulton, and Tisdale Weirs, and into the Sutter Bypass. The Sutter Bypass then drains the floodwater southward to Fremont Weir, where it crosses the main channel of the Sacramento River and flows via Yolo Bypass into the Delta.

Because most of the floodwaters overflowed upstream of Colusa the historical channel capacity was smaller in this reach of the river. This is reflected in today's design capacity of the channel in this reach which is only 30,000 cfs below Tisdale Weir as compared with an estimated 260,000 cfs in the Red Bluff to Chico Reach.

Several reclamation districts still exist, surrounded by levees. On the east side of the river, Reclamation Districts 70, 1660 and 1500 extend between the main channel of the river and the Sutter Bypass. The Sutter Mutual Water Company covers much of the same acreage as R.D. 1500. On the west side, Reclamation Districts 108, 787 and 730 cover the area between the river channel and the Colusa Basin Drain. Their responsibilities include the maintenance of both district and Project levees, drainage of lands within the districts. R.D. 108 and The Water Company also provide and maintain a water supply for irrigation. They work closely with the Reclamation Board to ensure that their activities are consistent with the operation of the Sacramento River Flood Control Project. These latter districts are included within the Sacramento River West Side Levee District which maintains the west side levees from Colusa to Knights Landing. Drainage activities are most critical during fall, winter and spring, when a combination of seepage from the main channel of the Sacramento River and precipitation require pumping water out of the districts into the river and bypass system.

Land Use

Land use acreage for this reach was determined using DWR land use surveys for Colusa, Sutter, and Yolo Counties (DWR 1993; 1990; 1989). Agricultural land use accounts for 23% of the area, riparian vegetation accounts for 40%, other native vegetation types about 21%, and 15% is classified urban or industrial. (Table 6-2)

Table 6-2. *Land Use within the Conservation Area, Colusa–Verona Reach*

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	645	23%	645	23%
Riparian Vegetation	1,113	40%	1,113	40%
Upland Vegetation	589	21%	589	21%
Urban	411	15%	411	15%
Water Surface (excluding main channel)	3	<1%	3	<1%
Miscellaneous (includes barren wasteland)	3	<1%	3	< 1%
Total Land Surface Area	2,764	100%	2,764	100%
Channel Surface Area	1,891		1,891	
Total	4,655		4,655	

*The purpose of DWR land use surveys is to map agricultural crops. Refer to Appendix D Part 2 for more accurate riparian vegetation data. Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding

Reclamation has enabled agriculture to become the predominant land use within the Conservation Area in this reach. The main crops are those suited to the deep loamy soils of the natural levees, including walnuts, peaches, prunes, tomatoes, beans, sugar beets, safflower, and corn. The Sacramento River provides the chief water supply; diversions are made directly from the river or from adjacent wells. The water table tends to be higher in the southern end of this reach, which is reflected in a greater percentage of row crops.

Of the four reaches, the Colusa to Verona Reach probably has the smallest population. Towns in this area include Meridian, Grimes, and Knights Landing. Boating and fishing are the most common recreational uses of the river. There are at least seven private marinas and fishing lodges and three official public access points. (Table 6-3; DPR, 1994).

The California Department of Fish and Game has recorded 205 water diversions in this reach. (Some diverters have more than one pump). The largest diversions are owned and operated by the Sutter Mutual Water Company and Reclamation District 108 (CDFG, 1994).

Table 6-3. *Public and Private River Access Spots, Colusa–Verona Reach*

RIVER MILE	ACCESS TYPE	FACILITY NAME
142.7 L	Private	Ralph's Steelhead Lodge
138.2 L	Private	Ward's Boat Landing
137.0 L	Private	Bob and Pat's Landing
124.4 R	Private	Grimes Boat Landing
119.5 L	Public	Tisdale Weir Fishing Access
96.6 R	Private	Missouri Bend River Access
92.8 L	Private	Fourmile Bend River Access
89.9 R	Public	Knights Landing County Park
89.9 L	Private	Knights Landing Marina
83.5 R	Public	Fremont Weir River Access
79.6 L	Private	Verona Marina

RIPARIAN VEGETATION

Current Acreage

The acreage estimates of riparian areas within the inner river zone are based on GIC (1997;2000) data and a recent estimate for “stringer vegetation”. All stands of riparian trees which were not identified in DWR maps were estimated for width and shoreline length. There are 1335 acres of riparian vegetation types within the inner river zone guidelines (Table 6-4).

Much of the riparian habitat in this reach exists as narrow stringers along levees and levee berms (Figure 6-2). In some areas levees are set back from the water edge, affording opportunity for larger areas of riparian habitat. Local Reclamation Districts maintain many of these areas. Examples of high quality mature riparian habitat and SRA exist within the set back levees. Figure 6-3 (Moon's Bend) and Figure 6-4 (Downstream of Colusa Bridge) show examples of such habitat. Limited areas of restricted meandering of the river channel occur between RM 126 and 130, resulting in bands of successional stages. Other areas contain little riparian vegetation (Figure 6-5).

Table 6-4. *Riparian and closely related vegetation within the Conservation Area*

Colusa-Verona Reach

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	1,149	41%	1,149	41%
Riparian Scrub	176	6%	176	6%
Valley Oak Woodland	0	0%	0	0%
Marsh	6	<1%	6	<1%
Blackberry Scrub	4	<1%	4	<1%
Total Riparian Vegetation	1,335	47%	1,335	47%
Total Land Surface Area	2,816		2,816	
Channel Surface Area	1,891		1,891	
Total	4,707		4,707	

GIC (1997; 2000). Percentages may not total due to rounding

Ownership

Public ownership accounts for less than 2 percent of the conservation area in this reach and at least 98 percent of the area (2,754 acres) is privately owned (Table 6-5). The state owns approximately 200 acres at the Beaver Lake/Collins Eddy and Mary Lake areas. The Knights Landing County Park is also a publicly owned parcel in this reach. There are 16 Sacramento River Bank Protection Project mitigation conservation easements (Chapter 7) in this reach, about 180 acres.



Figure 6-2. *Narrow “stringer” of riparian vegetation, Colusa–Verona Reach*



Figure 6-3. *Riparian vegetation near Moon's Bend (RM 138)*



Figure 6-4. *Riparian vegetation on waterside berm, downstream of Colusa Bridge*



Figure 6-5. Area with little riparian vegetation, Colusa–Verona Reach

Table 6-5. Land ownership within the Conservation Area, Colusa–Verona Reach

OWNERSHIP CATEGORY INNER RIVER ZONE GUIDELINE CONSERVATION AREA

	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	2,754	98%	2,754	98%
Public				
Federal	0	0%	0	0%
State	53	2%	53	2%
Local District, City, County	9	<1%	74	<1%
Total (Land Surface Area):	2,816	100%	2,816	100%
Channel Surface Area	1,891		1,891	
Total	4,707		4,707	

DWR Sacramento River GIS (May 2000); DPR (1994)

Restoration Strategy

As narrow as the existing band of riparian habitat corridor is within this reach, it can be excellent wildlife habitat, particularly where stands are contiguous, providing an important wildlife corridor. The SB1086 goal in this area is to restore and maintain a contiguous band of riparian vegetation within the Inner River Zone in a manner that follows the six guiding principles:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;
- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

Inner River Zone Guideline

The inner river zone guideline within Reach 4 consists of the floodway within the existing federally authorized flood control levees, and does not compromise the integrity of the levee structure or conflict with the operation and maintenance jurisdiction of local maintaining entities as designated by The Reclamation Board. The IRZ guideline does not include the weir or by-pass areas.

The Sacramento River Flood Control Project determines channel configuration in this reach. In addition, the natural channel dynamics are much different than upstream. A thorough geomorphological, engineering and environmental examination of this reach would be necessary to determine the soundest method of riparian habitat restoration. Projects in this reach should be evaluated according to the restoration priorities in Chapter 1.

1. Preserve intact processes

The ability of the river to meander in this reach is limited by the levee system. The area between RM 126 and 130 contains the banded appearance of various successional stages which are typical of riparian vegetation with active channel movement. Several significant riparian stands exist within the leveed areas (Table 6-6). *Purchase of such areas or landowner participation in voluntary programs within these areas should receive the highest priority for the protection of riparian habitat.*

Approximately 1,200 acres between the levees are in agricultural crops or support grasses and herbs. A recent review of 1995 aerial photos, taken during a four year recurrence interval flood event, suggests that all of these surfaces are covered by water on a fairly frequent basis. These areas could support early successional stages if left undisturbed.

2. Allow riparian forests to reach maturity

The DWR 1987 data suggest that the majority of the riparian vegetation within and adjacent to the levees is largely climax vegetation. Only 565 of the 1,928 acres of riparian habitat within the levees is subclimax or young vegetation. This may indicate that early stages are being removed through maintenance activities. All stages of

riparian vegetation are important for the survival of a diverse assemblage of wildlife species. *Management of existing and newly established vegetation should be done with a goal of increasing the diversity of riparian types.*

Table 6-6. *Significant areas of native vegetation and potential “natural restoration” areas between levees*

RIVER MILE	NAME OF AREA
138	Moon's Bend
130 – 126	Ogden Bend to Girdner Bend
120 – 119	North of Tisdale weir
111	Boyer's Bend
106	Poker Bend
105.5 – 103.5	China Bend
103-101	Tyndel Landing
101-99	Upstream of Eldorado Bend
	Outside of levee also
97	Missouri Bend
96	Victor Bend
94	Upstream and Downstream of Railroad Bend
88-87	Portuguese Bend/Mary Lake

3. Restore physical and successional processes

This reach contains potential areas for setback levees. Setback levees within this reach need to be investigated from an engineering feasibility as well as a riparian restoration feasibility standpoint.

4. Conduct reforestation activities

Restoration of the area between levees through “natural” restoration should receive the highest priority. Active restoration should be conducted in areas of high terraces and berms which do not receive an adequate flooding regime for the establishment of riparian vegetation.

The effect of riparian restoration on river stage, velocity and sediment transport should be evaluated before implementing projects. *The protection and restoration of a contiguous riparian strip down the rivers edge should also receive the highest priority.* Areas outside of this corridor should be evaluated for restoration based on the ability to restore large blocks of habitat, linkage to other blocks of riparian or valley oak woodland as well as proximity to the main channel or sloughs and tributaries.

Current Conservation and Management of Riparian Habitat Along the Sacramento River

There are currently several programs that conserve or restore riparian habitat along the Sacramento River. The main objective of these programs varies, but includes conservation, mitigation, and flood management.

CONSERVATION PROGRAMS

CALFED Bay-Delta Program

The CALFED Bay-Delta Program was formed in 1994 as a part of the Bay-Delta Accord and represents a collaborative effort among state and federal agencies and the public. The mission of the Program is “to develop a long-term, comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta System”. The system is a network of waterways created at the junction of the San Francisco Bay, the Sacramento and San Joaquin Rivers, and the watershed that feeds them. The CALFED Program is now in phase III which is implementation of the preferred alternative. The strategies and elements of the Program will contribute to improvements in the four resource areas: water quality, water use efficiency, ecosystem restoration, and levee system integrity. Prior to each proposed action, a site-specific detailed environmental review will occur. CALFED has funded ecosystem restoration projects that are consistent with the overall Program. Some of those include fish screens, fish ladders, habitat restoration, and research and monitoring projects. It is anticipated that actions in the long-term solution will be implemented in stages over the next 30 years. A federally-chartered group of stakeholders from urban, agricultural, business, environmental, and other interests are serving as members of the Bay-Delta Advisory Council (BDAC). The group acts in an advisory capacity to review the Program’s progress, provide comments and suggestions, and provide a forum for public participation.

Sacramento River Project (The Nature Conservancy)

The Nature Conservancy’s Sacramento River Project is a riparian protection, restoration, and sustainable agriculture project focusing on sites along the main stem of the river between Red Bluff and Colusa (100 river miles). The Nature Conservancy (TNC) works with a number of public and private partners to protect and restore flood-prone lands. Aspects of the project include land protection, riparian restoration research and development, large-scale restoration implementation, and a sustainable farming program. Outreach to local communities is a component of all aspects. The Project contributes to the improvement of the river’s ecological health and the protection of the area’s rich diversity of plant and animal life. As a crucial part of this project, TNC seeks to develop and demonstrate examples of successfully integrated land use along the Sacramento River.

Acquisition and Restoration

To address the drastic reduction of riparian habitat along the Sacramento River (Chapter 2), TNC has been involved in acquiring flood-prone lands since the 1980s, with the goal of restoring these lands to create large contiguous blocks of riparian forest. Working closely with a variety of public partners and willing sellers, TNC acquires existing riparian forest habitat for protection and flood-prone agricultural lands for restoration. Through riparian restoration research conducted over several years, TNC has explored biologically and economically feasible methods of restoration and monitoring to assess the effectiveness of the restoration, including wildlife of restoration sites. This has involved developing of large-scale, cost-effective techniques that can be demonstrated to public and private landowners and managers

interested in implementing riparian restoration. These techniques have been refined to include methods that can be duplicated using some traditional farming techniques. Restoration plans have been provided to local landowners and restoration manuals have been prepared that outlines tools and techniques for riparian restoration based on TNC's research and implementation.

Sustainable Farming

Recognizing the critical role that agriculture plays in both the environmental and economic health of the Sacramento River watershed, TNC initiated a sustainable farming program in 1994 to address the long-term compatibility of agriculture and wildlands. The goal is to promote farming methods that are both economically viable and environmentally sound. Working with California State University, Chico (CSUC), UC Extension, and local farmers, TNC has encouraged field trials of biological pest control practices on several TNC managed farms. In 1996, with funding from Department of Pesticide Regulation, TNC launched the Biological Prune System Program that provides free education and technical support to growers interested in adopting sustainable practices. Nine growers currently are enrolled in this voluntary program.

Kopta Slough Partnership

In the 1980s, TNC took on its first riparian restoration project at Kopta Slough, near Corning. TNC manages this 700-acre property, owned by the State Controller's Trust. It serves as the main research and development site for refining riparian restoration technology. This includes experimenting with techniques potentially compatible with both agricultural production and riparian restoration, with the intent of keeping the land productive during the time that restoration plantings are maturing. Development of successful techniques may also lower the cost of restoration per acre. To date, 140 acres have been planted with riparian forest species.

Phase I Mitigation Partnership

In 1990, TNC entered into an agreement with the U.S. Army Corps of Engineers (USACE), Bureau of Reclamation (USBR), and U.S. Fish & Wildlife Service (USFWS) to restore 260 acres of land adjacent to the river as mitigation for an USACE bank stabilization project (Chapter 2). Five sites, a total of 203 acres, have been planted to date: River Unit in 1990; Sam Slough Unit in 1991; Princeton Ferry Unit in 1992; Loman Unit in 1994; and Shaw Unit in 1995. After the first year of planting, two years of irrigation and weed control are conducted. After the third year, active management and maintenance cease and the unit becomes self-sustaining. River, Sam Slough and Princeton Ferry Units are no longer under active management/maintenance. Loman and Shaw Units are still being actively managed and maintained. All sites are monitored annually.

Llano Seco Ranch Partnership

TNC purchased a conservation easement in 1991 from the Parrott Investment Company, owner of Llano Seco Ranch, in Butte County. The easement applies to 2,900 acres of riparian forest, oxbow lakes, and cultivated field cropland on the 18,000 acre ranch. A goal for riparian and grassland restoration work on the easement site is to work cooperatively with the landowner to conduct restoration in a compatible manner with ongoing farming activities.

U.S. Fish and Wildlife Service Partnership

TNC has been working with the USFWS since 1991 to protect and restore riparian forest along the River (see following section). TNC assists USFWS with acquisitions of land to be included in the Sacramento River National Wildlife Refuge and manages these properties under a Cooperative Land Management Agreement. Agricultural lands are leased to local farmers, with some of these farmers involved in the restoration implementation. Recently, a local landowner under contract with TNC restored 50+ acres of USFWS property adjacent to his own lands to reduce the risk of flood damage to his fields.

Another partner is the Point Reyes Bird Observatory which has been monitoring birds in riparian forest adjacent to farmlands and in restoration sites to help determine wildlife use in these areas. Additionally, TNC has been working with CSUC, giving students direct, hands-on experience with sustainable farming and riparian restoration. CSUC is propagating more than 29,000 native plants for use in riparian restoration sites along the River. Additional partners include UC Cooperative Extension and private pest management companies.

The Sacramento River National Wildlife Refuge (U. S. Fish and Wildlife Service)

The purpose of the Sacramento River National Wildlife Refuge (NWR) is to preserve, restore, and enhance riparian habitat for threatened and endangered species, neotropical migrants, waterfowl and other migratory birds, anadromous fish, residential riparian wildlife, and plants. The riparian community is one of the most important wildlife habitats in California and North America.

Sacramento River NWR is a part of the Sacramento NWR Complex within the Sacramento Valley, is composed of fifteen separate units along an 80-mile stretch of the Sacramento River between Red Bluff and Butte City. The Refuge consists of 6,544 acres in fee title of a mixture of riparian habitat, wetland/uplands, intensively managed walnut and prune orchards, and row crops in Tehama, Butte, and Glenn counties. The Refuge administers 1,281 acres of riparian conservation easements which brings the total riparian acreage under the Refuge system to 7,825 acres.

The Refuge was established in 1989 by authority provided under the Endangered Species Act of 1973 and the Emergency Wetlands Resources Act of 1986, using funds available through the Land and Water Conservation Fund Act of 1965. The USFWS proposed acquisition of 18,000 acres of land for establishment of the Sacramento River NWR. The area considered for acquisition is located along the Sacramento River between Colusa and Red Bluff in Colusa, Glenn, Butte, and Tehama counties. A combination of fee title and conservation easement acquisitions will be used to protect this habitat.

Many of the activities of the Refuge are carried out in cooperation with other efforts. The Llano Seco Ranch is an example of one of these cooperative efforts. This historic wetland and riparian area, also known as the Parrot Ranch, covers 18,000 acres in Butte County. In 1991, a cooperative partnership involving the landowner, TNC, USFWS, and The Wildlife Conservation Board, completed an acquisition process that now protects 14,000 acres of the ranch under fee title or conservation easements.

The Sacramento River Wildlife Area and Other Properties (California Department of Fish and Game)

The California Department of Fish and Game (DFG) is managing riparian habitat within its Sacramento River Wildlife Area, as well as other locations on the river. These lands were acquired to preserve, enhance, and restore Sacramento River riparian wetland habitats, and to provide habitat for the wildlife species associated with the area, particularly threatened and endangered species. The Wildlife Area is between River Mile 215 (near the Butte-Tehama County Line) and River Mile 145 (near Colusa), and consists of 13 units totaling 3,615 acres. The management goal for this area is to allow river processes to maintain the components of the ecosystem, including channels, oxbow lakes, backwaters, banks, and associated terrestrial habitats. Long-range goals are to restore an unfragmented riverine-riparian ecosystem within the boundaries of the Wildlife Area, and to allow river processes to restore habitat types where feasible. These goals will ensure that habitat and species diversity will be maintained, and that listed species and their habitats will be preserved. In addition, future management will include the control of exotic species such as fig, tamarisk, and giant reed, and an agricultural component. Management will emphasize low-impact nonintensive public uses such as nature study, hunting and fishing. Public use will be affected by limited access, neighboring landowner and public safety concerns, and area closures and use constraints required for habitat and species protection.

Riparian Restoration-Agricultural Operations Program

DFG currently contracts with the CSUC University Farm to manage prune and almond orchards and field crops at the Pine Creek Unit (Jenny Lind Bend: RM 195-197). Agricultural operations at the site are integrated with riparian restoration needs and provide a source of funding for restoration of the site.

Other Parcels

In addition to the 13 units within the Sacramento River Area, Island Fishing Access, Mouth of Cottonwood Wildlife Area, Battle Creek Public Access, Bonnyview Road Fishing Access, Bend Bridge Public Access, Anderson Fishing Access, DFG owns and manages several other parcels of riparian habitat; about 950 acres, within the proposed Conservation Area. These include Turtle Bay East Fish Access, Reading Red Bluff River Park and Fishing Access, Beaver Lake and Collins Eddy. The fishing access sites are generally managed by local cities or counties, generally managed the fishing access sites under a cooperative agreement with the state.

Private landowners also work with DFG to conserve riparian habitat through conservation easements. Along the Sacramento River, these easements total approximately 350 acres.

Sacramento River Area (Bureau of Land Management)

The Bureau of Land Management (BLM) is working to acquire 19,000 acres of undeveloped lands within Tehama County north of Red Bluff (Redding Reach) to protect the area's riparian and wetland values, enhance the river's anadromous fisheries and provide continued recreation opportunities. Acquisitions and land exchanges are being carried out with monies from the Land and Water Conservation Fund.

BLM also owns and manages two parcels in the Red Bluff - Chico Reach, Foster Island, a 250 acre parcel of riparian habitat at River Mile 211, and Todd Island, a 223 acre parcel at River Mile 237.

The Sacramento River Area, located in Tehama County, encompasses 40,000 acres in a 26-mile river corridor. Nearly 27,500 acres are in private ownership, the state owns 500 acres, and the remaining 12,000 acres are in BLM ownership. Nearly 90 percent of the total area remains in pristine condition.

BLM has been working to consolidate federal ownership within the Sacramento River Area for more than 20 years. Included in BLM's ownership are 14 miles of critical river frontage, 100 acres of wetlands and 600 acres of nesting habitat for waterfowl and shore birds. Through BLM's 1993 Redding Resource Management Plan (RMP), portions of the river and its tributaries were determined eligible for inclusion in the National Wild and Scenic River System. The area provides habitat for the endangered bald eagle and tadpole shrimp and numerous sensitive and proposed listed species plants. The river's waters provide habitat for the federally listed endangered Chinook salmon. BLM partnerships include:

- Working with DFG is to preserve wildlife and fish habitat within the area.
- The Wildlife Conservation Board (WCB) has provided funding for acquisition and wetland projects and the American Land Conservancy, the Trust for Public Land, and Sierra Pacific Industries have played a major role in land acquisitions.
- BLM entered into a cooperative agreement with the Santa Clara Unified School District in 1987 to facilitate the construction and maintenance of various trails and facilities within the area. The school district also uses the area for summer environmental programs.
- Cooperative agreements completed with CSUC and Shasta College have been integral to the conservation and inventory of important cultural sites.
- BLM has worked with the California State Lands Commission to develop an agreement to give BLM management responsibility over two state-owned Islands where there was extensive and uncontrolled public use.
- Tehama County, Wildlife Conservation Board, Department of Boating and Waterways, and BLM are working together to provide a well designed and managed boat launching and day use facility near the community of Bend. Orientation/Information displays and a wheelchair accessible fishing platform and dock have been provided in part by a grant from the El Paso Natural Gas Company. The Bend School District has entered into a cooperative environmental education program with the BLM, and has adopted the Bend Facility.

State Parks (California Department of Parks & Recreation)

The California Department of Parks and Recreation (DPR) owns and manages five parcels of riparian habitat along the Sacramento River. These are the William B. Ide Adobe State Historical Park, Woodson Bridge State Recreation Area, Irvine Finch River Access, Bidwell River Park State Recreation Area, and the Colusa-Sacramento River State Recreation Area. These holdings total approximately 700 acres with many types of riparian habitat. The Woodson Bridge State Recreation Area includes

both sides of a river bend and contains one of the best remaining remnants of high terrace valley oak woodland along the river.

Other Holdings (Various Agencies)

In addition to these established programs, a few miscellaneous parcels exist on which the habitat is protected under public ownership. These include city parks and a few parcels owned by the State Lands Commission (SLC). The largest SLC holdings are a 50-acre site at Battle Creek (managed by BLM), a 40-acre site at Lawrence Island (RM 269, Redding to Red Bluff Reach) and a 127-acre site at Mary Lake (RM 87-88, Colusa to Verona Reach).

MITIGATION PROGRAMS

Riparian vegetation may be removed during the course of USACE bank protection work. The resulting bank protection and associated maintenance activities may preclude the natural reestablishment of the lost habitat. As a result, USFWS has required mitigation for these activities. Mitigation measures have taken several forms; one of which is the protection of riparian habitat through environmental easements and on lands that the Reclamation Board has purchased in fee from willing sellers.

Land and Easements—Sacramento River Bank Protection Project Mitigation (U.S. Army Corps of Engineers, California Department of Water Resources)

The easements purchased between Chico Landing (RM 194) and Collinsville (in the Sacramento-San Joaquin Delta) are between the waterside levee toe and the river on the waterside berms along the levees of the Sacramento Valley Flood Control Project. Easements purchased above Chico Landing include additional strips along the top of Chico Landing to Red Bluff Project rock riprap. DWR's Encroachment Control Section inspects the easements twice yearly. Inspectors look for any encroachments or unauthorized activity in these areas. There are approximately 32 of these easements totaling 300 acres.

The Reclamation Board owns two mitigation parcels (Phelan Island and Murphy Slough) totaling approximately 780 acres within the Conservation Area in the vicinity of Chico Landing. These two parcels were acquired as mitigation for construction and maintenance of the Sacramento River Bank Protection Project.

Evaluation of Mitigation Measures

USFWS completed an evaluation of selected bank protection sites (Units 27-36) in 1987. The results of this evaluation indicated that one environmental measure (rock fill), which was to help protect berm areas, was costly and generally failed to ensure preservation of riverbank wildlife habitat. A second measure, acquisition of environmental easements, was also determined to be costly and only partially successful, determining that the major problem and habitat-limiting factor at most sites was the overuse of fire and discing by landowners and reclamation districts to eliminate vegetation cover, USFWS made several recommendations for improving the success of mitigation work.

In 1991, the USFWS completed a second evaluation of the effectiveness of mitigation measures employed under the SRBPP. Mitigation measures evaluated included land acquisition, experimental artificial bank swallow nesting habitat, and experimental fishery mitigation structures (rock fill was not evaluated due to a lack of information regarding sites where this measure was used). The results of this evaluation indicated that while replanting efforts were successful, lands acquired generally remained in the same condition as when acquired. In addition, the USFWS found that experimental bank swallow and fishery mitigation structures did not fully replace habitat values lost by conversion of natural banks to rock revetment.

FLOOD MANAGEMENT PROGRAMS

Murray, Burns and Kienlen Sites (The Reclamation Board)

The Reclamation Board has adopted policies to preserve riparian vegetation within the Sacramento Flood Control Project. The Board contracted with the engineering firm of Murray, Burns and Kienlen (MBK) to conduct a study to determine if riparian vegetation could help to the course of the river. The 1978 report of that study identified 38 riparian vegetation sites totaling 4,100 acres that serve a flood control function by contributing to the overall stability of the Sacramento River and its overflow areas between Tisdale Weir and Hamilton City. The Board accepted the findings of that report as a plan of flood control. The vegetation on some of these sites provides important benefits to flood control by reducing the effects of high velocity flows. These floodflows cause serious erosion to river banks and levees and subsequent sedimentation of downstream facilities.

About 440 acres of these sites have been purchased from willing sellers through 1990 and are currently owned by the State of California (Reclamation Board). In addition, other sites have been acquired as part of the Sacramento River National Wildlife Refuge, the Sacramento Wildlife Area (see above descriptions), or other programs.

Designated and Regulatory Floodways (The Reclamation Board and the National Flood Insurance Program)

Both the Reclamation Board and the National Flood Insurance Program (NFIP) have regulations and guidelines regarding land use in floodways. A *designated floodway*, as defined by the Board, is the river channel and that portion of the adjoining overflow floodplain required to reasonably provide for passage of the 100 year flood (Chapter 2). A *regulated floodway*, as defined by the National Flood Insurance Program, is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. Many portions of the Sacramento River fall under one or both of these designations.

The Board's designated floodway is a nonstructural means of preventing uses and structures from encroaching into waterways, obstructing floodflows and increasing flood damage. It reduces the impact of flooding by preserving the reasonable flood passage capacities of natural watercourses and floodways. Local communities, as well as special districts and county governments, are encouraged to enter actively

into the Designated Floodway Program, to incorporate designated floodway maps as part of their zoning ordinances, and to develop sound floodplain management practices. The NFIP prohibits development within the regulatory floodway unless it can be proven that there will be no rise in the base flood elevation, i.e., the water surface elevation of the 100-year flood. Development, including structures, is permitted in fringe areas of the 100-year floodplain outside the regulatory floodway, but must meet specific development standards.

The Sacramento and San Joaquin Rivers Basins Comprehensive Study

The “Comprehensive Study” was authorized in 1997/98 through joint actions of Congress and the California State Legislature. It is a joint study by the California State Reclamation Board and the U.S. Army Corps of Engineers “to develop a system-wide, comprehensive flood management plan For the Central Valley to reduce flood damages and integrate ecosystem restoration”.

-Phase I focused on evaluating current conditions, developing hydrologic and hydraulic models, identifying flooding and related environmental problems, formulating preliminary planning objectives, initiating a public involvement program, collecting potential solution measures, and developing a plan of action for Phase II.

-Phase II is concentrating on fully implementing the public involvement program, conducting feasibility-level assessments, developing concept approaches and the Starting Point Plan.

Riparian Habitat Along the Sacramento River: Local, State, and Federal Agencies and Private Organizations

Many different public and private agencies and organizations are currently involved with riparian habitat management along the Sacramento River.

At the local level, the Conservation Area includes portions of seven counties. The cities of Redding, Anderson, Red Bluff, Tehama, and Colusa, as well as several unincorporated communities lie partially within the proposed Conservation Area (Table 8-1). In addition, many irrigation, reclamation, flood control, levee maintenance, and resource conservation districts each play different roles along various portions of the river. At the state and federal level, a variety of agencies are involved in riparian habitat management issues.

While each of these jurisdictions has a defined role, their sheer number, variety, and overlapping boundaries can be quite confusing. The proposed nonprofit organization can play an important role by serving as a liaison between landowner, conservationist, and these local, state, and federal jurisdictions. The organization can also serve as a clearinghouse for information related to these various entities along the river, and as a guide through procedures for grant applications or environmental permits. The many jurisdictions and agencies along the river can also help the nonprofit organization and participating public and private landowners in achieving the goals of preserving and reestablishing continuous riparian vegetation and a riparian ecosystem along the Sacramento River.

This chapter describes only those entities most closely linked with riparian habitat management along the river. In the course of its work, the nonprofit organization may need to coordinate with many other entities not listed in this chapter. Such entities may include local mosquito abatement and drainage districts, municipal water companies, or community services districts.

LOCAL AGENCIES

Local entities along the Sacramento River include counties, cities, resource conservation, flood control, irrigation, reclamation, and levee maintenance districts (Table 8-1).

This section describes the policies, ordinances and codes of these entities as they relate to riparian habitat along the river.

Table 8-1. Local jurisdictions within the Sacramento River Conservation Area

INCORPORATED CITIES

Redding	Tehama
Anderson	Colusa
Red Bluff	

COMMUNITIES

Bend	Butte City
Gerber	Princeton
Los Molinos	Meridian
Hamilton City	Grimes
Ord	Kirkville
Glenn	Knights Landing
	Verona

LEVEE AND RECLAMATION DISTRICTS

Reclamation District 2047
Reclamation District 1004
Reclamation District 70
Reclamation District 108
Reclamation District 787
Reclamation District 730
Sacramento River Westside Levee District
Levee District 1
Levee District 2
Levee District 3

FLOOD CONTROL AND DRAINAGE DISTRICTS

Los Molinos Mutual Water Company
Tehama County Flood Control and Water
Conservation District
Yolo County Flood Control and Water
Conservation District
Colusa Basin Drainage District

COUNTIES

Shasta	Colusa
Tehama	Sutter
Butte	Yolo
Glenn	

RESOURCE CONSERVATION DISTRICTS

Western Shasta Resource Conservation District
Tehama County Resource Conservation District
Vina Resource Conservation District
Glenn County Resource Conservation District
Colusa County Resource Conservation District
Sutter County Resource Conservation District
Yolo County Resource Conservation District

IRRIGATION AND WATER DISTRICTS

Anderson-Cottonwood Irrigation District
El Camino Irrigation District
Glenn-Colusa Irrigation District
Provident Irrigation District
Princeton-Codora Glenn Irrigation District
Tisdale Irrigation District
Feather Water District

PRIVATE WATER AND IRRIGATION COMPANIES

Tisdale Irrigation Company
Stanford Vina Ranch Irrigation Company
Tehama Ranch Company
Meridian Farms Water Company
Roberts Ditch Irrigation Company
Pelger Mutual Water District
Sutter Mutual Water Company
Natomas Central Mutual Water Company

Counties and Cities

Each of the seven counties and the incorporated cities within the Sacramento River Conservation Area is required (Government Code 65000 et seq) to have a general plan that addresses open space, conservation, safety, land use, and circulation issues. The purpose of these plans is to help communities develop a vision and goals

for the future. Plans are usually revised about every 5 to 10 years. General plans contain “elements” discussing specific areas of concern within the county or city. References to the Sacramento River are most often found in the Conservation and Open Space elements. It should be noted that the policies recommended within a general plan do not become law unless the county passes an ordinance or zoning regulation related to the issue. All zoning ordinances, public works decisions and subdivision map approvals, however, are to be consistent with the general plan.

Several other state and federal laws implemented at the county level affect riparian habitat resources:

THE SUBDIVISION MAP ACT establishes procedures for local government to follow when land is subdivided. To ensure that subdivision does not harm public resources, the law requires environmental review under the California Environmental Quality Act. The Act also allows local governments to require a variety of set-asides for the benefit of community residents. These may include land, public facilities, or payment of “in lieu” fees for various facilities, as well as easements to provide public access to rivers and streams. Additionally, the Act specifically gives local governments the option of requiring developers to dedicate local park acreage, pay equivalent fees for local governments to acquire parkland, or some combination of both. These options can help maintain riparian habitat along urbanized and urbanizing reaches of the Sacramento River.

THE SURFACE MINING AND RECLAMATION ACT OF 1975 (and amended many times since) requires that a surface mining operation obtain a permit from and submit a reclamation plan to the county or city in which it is located. The local government is not only responsible for the permitting, but for follow-up on approved reclamation plans. Because instream and near-stream mining can have such significant impacts on the character of both upstream and downstream reaches of a system, the local role may be pivotal for the continued well-being of the system as a whole.

THE NATIONAL FLOOD INSURANCE ACT OF 1968 establishes local, state, and federal responsibility for ensuring that federal flood insurance is available, while also attempting to reduce exposure to flood hazard risks through local and state regulation. When participating communities adopt and enforce floodplain management regulations, residents and businesses are then able to purchase federal flood insurance. Local jurisdictions along the Sacramento River have generally adopted ordinances that put them in compliance with the federal law. Because these ordinances may restrict the type of development in floodplain areas, they may have an indirect impact on the riparian habitat of the river corridor.

SHASTA COUNTY

General Plan

The Shasta County General Plan, recognizing the Sacramento River as one of the most important county and state natural resources, seeks to protect its fish, wildlife and vegetation resources. It seeks a balance between habitat protection and management of agricultural and timber lands. The plan recommends minimizing sedimentation and erosion through grading and hillside development regulations.

Shasta County has designated significant creek and riverside corridors on general plan maps in order to protect riparian habitat from adverse impacts related to development

or conflicting land use. Public access and easements for recreation are encouraged as long as riparian habitat will not be significantly affected. The following policies are designed to protect such areas: 1) vegetation removal is regulated; 2) grading and road construction is regulated; 3) development set-backs are required for new projects; 4) structure siting is regulated often involving clustering in order to minimize impacts; 5) recreation plans are regulated.

The Shasta County General Plan encourages and supports DFG's Upper Sacramento River Stream Corridor Protection Program. The county consults DFG on all development applications that propose changes to streamside areas.

Salmon and steelhead trout spawning gravels are protected. Aggregate mining projects are permitted only if stream disturbance is minimal. Restoration activities are recommended. Mining in the vicinity of waterways is discouraged (Shasta County, 1993).

Codes and Ordinances

Although no changes to the county code have been made yet, Shasta County's planning department plans to integrate the goals of the Upper Sacramento River Stream Corridor Protection Program with existing county codes. CDFG is consulted regularly when development applications are submitted that have an impact on the Sacramento River. Shasta County has also adopted a floodplain ordinance consistent with the federal legislation.

FOR FURTHER INFORMATION:

Shasta County Community Planning
1855 Placer Street
Redding, CA 96001-1759
Phone: (530) 225-5532

TEHAMA COUNTY

General Plan

The Tehama County General Plan recognizes that water resources are essential to the environmental and economic well-being of the county and that water resources and supply systems should be protected and conserved. Tehama County has designated significant river and creek-side corridor land use sub-categories, which delineate areas considered essential for groundwater recharge, as well as areas considered in need of bank protection.

The general plan recommends preservation of environmentally sensitive lands and water, recognizing the recreational, educational, and ecological value of the county's abundant wildlife. The plan states that the county will work with other agencies for proper riparian restoration and management. The county cooperates with DFG on the Upper Sacramento River Stream Corridor Protection Program. DFG's development set-back recommendations are used as guidelines for approving development applications that encroach on native riparian areas. Significant river, creekside corridor, and natural resource areas are designated on zoning maps. The county also recommends purchasing private lands that front the Sacramento

River for conservation purposes. The county encourages easement donations from private land-owners (Tehama County, 1993).

Codes and Ordinances

TEHAMA COUNTY CODE CHAPTER 9.16 requires that all watercourses remain unobstructed by dams, fences, structures, debris, or any other material in order to prevent unnecessary flooding that could injure neighboring property or people. Individual property owners are responsible for maintaining unimpeded waterways; if the property owner does not abide by this code a special assessment against the property is made.

TEHAMA COUNTY CODE 17.08 states that commercial excavation of natural materials is not permitted in the floodways of the Sacramento River or the main and south forks of Cottonwood Creek. Excavation activities already in operation when this law was passed are permitted to continue.

TEHAMA COUNTY CODE CHAPTER 17.42 allows farming, gardening, grazing, etc. within the Primary Floodplain District without permit. The placing of buildings (or other structures) or public use and diversion structures within this floodplain requires a permit.

TEHAMA COUNTY CODE CHAPTER 17.44 deals with natural resource lands and reclamation districts. Measures to promote soil, water, and vegetation conservation or to reduce erosion and fire hazard are permitted within natural resource areas. These measures may include stables, parks, picnic sites, farming, grazing, boat launching and utilities establishment.

TEHAMA COUNTY CODE CHAPTER 15.52 regulates development within floodways and areas of special flood hazard status, consistent with federal legislation.

Tehama County Code Chapter 13.28 defines standards for surface mining operations in compliance with the 1975 California Surface Mining and Reclamation Act. The County requires mining permit applicants to disclose hours of operation, the amounts of noise and dust that will be created as a result of the activity, as well as fencing and aesthetic considerations. The Tehama County Planning Department is responsible for reviewing all applications and approving all permits.

TEHAMA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

This special district was formed under a state act in 1957. Its purpose is to provide for control, conservation and deposition of storm and flood waters of the district. It also makes water available for any present or future uses of lands or inhabitants within the district, including acquisition, storage, and distribution for irrigation, domestic, fire protection, municipal, commercial, industrial, recreational and all other beneficial uses.

Key district programs include:

- Coordinated AB 3030 Groundwater Management Plan for Tehama County
- Integration with the Incident Command System for Tehama County, which provides emergency management duties during declared flood disaster events
- Drainage improvement studies/capital improvement programs

- Development of county grading ordinance
- Administration of watercourse obstruction ordinance
- Maintenance of flood control facilities throughout the county (TCFC&WCD, nd.)

FOR FURTHER INFORMATION:

Tehama County Planning Department
444 Oak Street, Room 1
Red Bluff, CA 96080
Phone: (530) 527-2200

Tehama County Flood Control and Water Conservation District
9380 San Benito Avenue
Gerber, CA 96035
Phone: (530) 385-1462

BUTTE COUNTY

General Plan

The Butte County General Plan (updated, 1977) is being amended at this time. The general plan does not outline any specific recommendations regarding the Sacramento River, but deals with the river indirectly in various portions of the plan.

The land use element, drafted in 1991, states that it is the county policy to maintain quality and quantity of water resources and ensure their adequacy for all county uses. Development should be controlled in watershed areas in order to minimize erosion and water pollution. Water conservation efforts are encouraged in all plans for new development. The county recognizes that a variety of wildlife species require riparian habitat areas and that, therefore, these regions require protection. In addition, the county encourages compatible land use patterns in scenic corridors and areas adjacent to scenic waterways, rivers and creeks. The county however, has not placed any restrictions, codes and ordinances on extraction of mineral resources in streamside areas (Butte County, 1977; 1991).

FOR FURTHER INFORMATION:

Butte County Development Services
7 County Center Drive
Oroville, CA 95965-3334
Phone: (530) 538-7601

GLENN COUNTY

General Plan

Glenn County identifies goals and policies within its general plan that address conservation issues along the Sacramento River. While the county has created a map overlay that outlines groundwater and streamside areas recommended for protection, county ordinances have not yet been amended to include development standards

that protect watershed areas. Map overlays for restorable wetlands and areas of biological importance have also been created. Watershed protection standards recommend that all new developments proposed adjacent to streams include grading, excavation and erosion control plans to minimize degradation to soil and water quality. Development along the Sacramento River should avoid environmentally sensitive areas and eliminate or minimize any adverse impacts from all proposed projects.

The Glenn County General Plan recognizes the Sacramento River corridor as an area of significant biological importance. County policy encourages preservation of the natural riparian habitat along the Sacramento River as well as other watersheds, including Butte and Stony Creeks. Existing riparian vegetation should be protected and revegetation programs undertaken. Mitigation measures should result in no net loss of habitat productivity. The county works with DFG and USFWS, as well as conservation and preservation groups, to identify areas for restoration and enhancement.

The general plan suggests amending county zoning code to include a Streamside Protection Zone, but the county has not addressed this recommendation. The county has recently applied for a federal grant to fund preliminary watershed protection studies.

Mining and mineral resources are also addressed in the Glenn County General Plan. Mineral extraction is permitted, but is required to be compatible with surrounding land use and should not affect the environment. The use-permit process decides when and where these activities can occur. The Extractive-Industrial zoning designation has been removed from areas containing natural riparian habitat and changed to agricultural or light-industrial status; this is meant to provide greater protection to habitat areas previously subject to mining activities (Glenn County, 1993).

Codes and Ordinances

GLENN COUNTY CODE 16.16 outlines regulations for land leveling and changes to conditions.

GLENN COUNTY CODE 16.24 details the minimum standards for dealing with public drainage courses. Maps, plans and profiles are required to describe the present site conditions, proposed work plan, adjacent land uses and proposed finished site and private losses due to flooding. The purpose of this law is to minimize loss and damage to life and property, ensure that potential buyers are aware of flood hazards and ensure that individuals occupying areas of flood hazard are responsible for their actions. It establishes general standards related to subdivisions, utilities and storage of material and equipment as well as specific standards regarding residential and non-residential construction and mobile homes.

GLENN COUNTY CODE 21.04 sets county regulations in accordance with the 1975 Surface Mining and Reclamation Act. Applicants for mining permits are required to: identify landowners and mineral rights holders, specify dates of activity, quantity and type of materials to be removed, contain site maps and descriptions of existing conditions, and operating and reclamation plans. A public hearing is required before the permits are granted and annual inspections are conducted. This code also considers idle and abandoned mines. (Glenn County Code, 1995).

FOR FURTHER INFORMATION:

Glenn County Resource Planning and Development Department
125 South Murdock Avenue
Willows, CA 95988
Phone: (530) 934-6540

COLUSA COUNTY

General Plan

The Colusa County General Plan recognizes there are sensitive lands along the Sacramento River that contain rare species. The plan also recognizes that much of the Sacramento River's riparian vegetation has been destroyed as a result of agriculture, flood control, and channelization. County policy recommends habitat resource conservation and protection of water quality and quantity.

The Resource Conservation Element of the Colusa County General Plan encourages conservation of fish and wildlife habitat throughout the county. Preservation of the natural qualities of rivers and streams is also encouraged. Zoning, planning, and taxation policies should preserve watershed areas, as well as agricultural lands and hillside areas. Development in the Sacramento River floodway and ecologically sensitive areas is discouraged. The Open Space and Recreation Element additionally encourages the conservation of the natural beauty of rivers and streams (Colusa County, 1989).

FOR FURTHER INFORMATION:

Colusa County Planning and Building
220 12th Street
Colusa, CA 95932
Phone: (530) 458-0480

SUTTER COUNTY

General Plan

The Open Space Element of the Sutter County General Plan keeps its discussion of goals and policies related to the Sacramento River somewhat general. The plan identifies the importance of natural resources and encourages development projects that minimize impacts to open space and wildlife habitat areas.

The Natural Resources section encourages the preservation and protection of water resources. In cooperation with DFG's Stream Corridor Protection Program, the county's policies encourage development set-backs from all water courses and the protection of water recharge areas. Wetland and riparian areas are defined as significant areas that are important to protect. The county has established a policy of no net loss of wetlands. In addition, surface runoff from agricultural or other uses is discouraged from diversion into wetland areas. The county recommends the preservation of areas of high habitat value by supporting preservation and reestablishment of fisheries. Riparian areas are to be protected and the planting of native and drought tolerant plants are encouraged (Sutter County, 1994).

Codes and Ordinances

SUTTER COUNTY SURFACE MINING AND RECLAMATION CODE requires that all extractive activities, such as mining, submit reclamation plans to the county and receive permit approval before operations in stream-side areas can begin.

SUTTER COUNTY ZONING CODE SECTION 7910 establishes a Flood Plain Combining Zoning District within which development standards or use restrictions apply.

SUTTER COUNTY RESOLUTION 92-124 states that any development in special flood zone hazard area, as defined by FEMA, must submit an elevation certificate by a licensed surveyor.

FOR FURTHER INFORMATION:

Sutter County Planning Department
PO Box 1555
Yuba City, CA 95992
Phone: (530) 822-7400

YOLO COUNTY

General Plan

The Yolo County General Plan recommends maintaining waterways and riverbank corridors as part of its open space preservation program. Because of high scenic value. The plan includes maps which highlight these areas as significant. Other recommendations include protection and creation of wildlife habitat areas and the adoption of lists and maps of the distribution of natural features and other significant characteristics of the county's physical environment. The county's goal is to plan, encourage, and regulate natural resources in order to ensure long-term ecological benefits, and to prevent unnecessary disruptions to terrain, vegetation, and other resources.

All watershed areas are designated on county overlay maps for conservation purposes. Watershed areas are limited to the following activities: grazing; wild hay production; soil, water and wildlife conservation; and non-intensive recreation. The county requires conditional use permits to ensure conservation of natural vegetation.

The general plan does not permit sand and gravel mining operations in areas along the Sacramento River or its tributaries (Yolo County, 1983).

Codes and Ordinances

YOLO COUNTY CODE CHAPTER 3, TITLE 8, FLOOD DAMAGE PREVENTION requires that any obstructions built in the 100-year floodplain be above the 100-year flood level. A thorough review process is required before permits are issued.

Yolo County Habitat Management Plan

The county is currently working on a habitat management plan that encourages conservation easements and habitat protection zones within active agricultural fields and county sloughs. At present the focus has been on agricultural

areas and has not focused on habitat issues inside the Sacramento River levee system. The plan may incorporate these issues. Currently, the draft habitat management plan is undergoing city and county review (Yolo County, 1995; Hamblin, 1997 pers. comm.).

Yolo County Flood Control and Water Conservation District.

This special district was created by the state legislature in 1951, for the control and disposition of the storm and floodwaters of the district, and to make water available for any beneficial use of land or inhabitants (DWR, 1978).

FOR FURTHER INFORMATION:

Yolo County Planning Department
292 West Beamer Street
Woodland, CA 95695
Phone: (530) 666-8775

CITY OF TEHAMA

General Plan

The general plan for the City of Tehama encourages the recreational use of the Sacramento River. Streets that end at the bank of the river and portions of First Street that lie along the river are reserved for river access. In addition, city approval is required for the removal of trees (City of Tehama, 1972).

Code and Ordinances

ZONING ORDINANCE #89 – All river frontage not privately owned is reserved for the city to use for mini parks, river access, river bank control, wildlife preservation and scenic beauty and recreation (City of Tehama).

FLOOD ORDINANCE #130 – This ordinance sets standards for development within special flood hazard areas and prohibits development within floodways that would result in an increase in flood levels (City of Tehama).

FOR FURTHER INFORMATION:

City of Tehama
250 Cavalier Drive
Tehama, CA 96090
Phone: (530) 384-1501

CITY OF COLUSA

General Plan

The City of Colusa General Plan does not mention specific policies or goals related to the Sacramento River. Because the city is protected from the bordering Sacramento River by levees of the Sacramento Valley Flood Control Project, development in the area between the river and levees has not and will not occur.

The general plan recognizes that because of its proximity to the river, Colusa has abundant waterfowl and raptors. The plan also recognizes that the Sacramento River is of scenic importance to the community.

The Colusa-Sacramento River State Recreation Area consists of 63 acres just outside the city limits along the Sacramento River. The general plan asserts that it will support the continuation of this facility. The City of Colusa recognizes FEMA's boundary of the 100-year floodplain and, as a result, development on or within the levee system that borders the Sacramento River is not permitted (City of Colusa, 1994).

Downtown Development/Preservation Program

The City of Colusa developed a Downtown Development/Preservation Program in 1988 that outlines a comprehensive plan for the downtown commercial area. It recommends reducing the density of commercial activity in the area along the Sacramento River by changing zoning to lighter density commercial in approximately half of the area.

The program also recommends that Colusa "take advantage of its proximity to the Sacramento River." By recreating a downtown more accommodating to pedestrian travel, the town is hoping to promote enjoyment of the river (City of Colusa, 1988).

FOR FURTHER INFORMATION:

City of Colusa Planning Department
P.O. Box 1063
Colusa, CA 95932
Phone: (530) 458-4740

CITY OF REDDING

General Plan

The Redding General Plan recognizes the Sacramento River as the area's greatest physical asset. The city's stated goals and policies are to enhance and protect the River as well as provide increased public access. The city is working toward maintaining the scenic quality of waterways by encouraging planned public access areas and trail systems. The plan recognizes that preservation and maintenance of existing riparian vegetation is critical for scenic reasons. The plan recommends implementing of development standards that will prevent stream flooding and loss of habitat.

Redding also recommends minimizing grading impacts within the 100-year floodplain. The city recommends maintaining gravels within the 100-year floodplain for salmon spawning and has a policy of promoting vegetation growth near spawning pools and replanting riparian vegetation on stream and river banks where channel modification is deemed necessary.

The general plan recommends locating structures and developments (other than public parks) outside the riparian buffer area. Riparian corridors are recommended for the 100-year flood plain and facilitated by the creation of easements and fee deductions. The city's general policy is to prohibit all development within the 100-year floodplain.

The City Council has endorsed the DFG Stream Corridor Protection Program. Program maps will be used to work with developers so that site plans are developed with minimal impact to riparian corridors. Redding is working on implementing development set-back regulations in accordance with the program and plans to formalize such recommendations by amending the general plan.

The city requires all tentative subdivision applicants to provide maps of all streams, watercourses, and seasonal drainages in an anticipated project area. Riparian habitat must be delineated and a buffer defined that will protect such habitat. Slope and soils characteristics must also be defined and information on grading (existing and proposed conditions) is required (City of Redding, 1985).

Codes and Ordinances

REDDING MUNICIPAL CODE CHAPTER 18.47, COMBINING FLOODPLAIN DISTRICTS. This code restricts development within the 100-year floodplain to elevated structures.

FOR FURTHER INFORMATION:

City of Redding Planning Director
760 Parkview Drive
Redding, CA 96001-3318
Phone: (530) 225-4020

CITY OF ANDERSON

General Plan

The City of Anderson General Plan states that the areas of most significant habitat are along the Sacramento River and Anderson Creek. The city's policies focus on retaining riparian vegetation along waterways in conjunction with preserving wildlife habitat areas. One of the city's goals is to prevent degradation of area water resources due to development and growth; maintenance of quality and quantity of water is an important goal. The City of Anderson zoning code precludes mining operations along the Sacramento River within the city limits (Anderson, 1989).

Codes and Ordinances

CITY OF ANDERSON FLOOD DAMAGE AND PROTECTION ORDINANCE sets the flood-proofing and elevation criteria for any development within the 100-year floodplain (City of Anderson, April 1997 pers. comm.).

FOR FURTHER INFORMATION:

City of Anderson
Anderson Planning Department
1877 Howard Street
Anderson, CA 96007
Phone: (530) 378-6636

CITY OF RED BLUFF

General Plan

The City of Red Bluff General Plan suggests measures to protect and conserve the area along the Sacramento River. These measures include discouraging development within the riparian area and floodplains and cooperating with the county in promoting the protection of riparian habitat.

Red Bluff's general plan recommends conducting a wetland resources inventory for use in all land use decisions. A tree preservation ordinance has been suggested that would result in no net loss of native trees within the city limits. A list of native plants compatible with valley oaks is also being considered as a conservation tool.

The water resources section of the general plan promotes the conservation and improvement of ground and surface water resources. Watersheds and recharge areas are to be protected. The soils and vegetation in water recharge and percolation areas are to be preserved and maintained in their natural state. Reduction of sediments entering waterways is recommended ; projects reducing soil erosion are encouraged. A stated goal is to restrict urban intrusion into the floodplain area (City of Red Bluff, 1993).

Codes and Ordinances

ZONING CODE The small areas of riparian habitat within the city (such as Dog Island Park) are zoned as public agency lands, protecting them from development.

RED BLUFF'S FLOOD HAZARD PREVENTION ORDINANCE protects the Sacramento River and tributary streams from development within the 100-year floodplain by eliminating density credits from all new development within this area. Lots zoned for development prior to the passage of this ordinance, however, can develop. Structures must be built so that they are above the flood line.

FOR FURTHER INFORMATION:

City of Red Bluff
555 Washington Street
Red Bluff, CA 96080-3433
Phone: (530) 527-2605

Resource Conservation Districts

Resource conservation districts (RCDs) are formed in accordance with Division IX of the Public Resources Code for the State of California. RCDs are special districts with local responsibility for addressing such resource issues as non-point source pollution, soil erosion, loss of prime and unique farmland, improvement of grazing and the promotion of integrated pest management practices. RCDs work closely with the USDA Natural Resources Conservation Service and other technical assistance agencies through memoranda of understanding, to address resource concerns through technical and financial assistance programs and conservation education. RCDs often make recommendations to county planning departments and boards of supervisors on soil, habitat and drainage-related issues associated with land conver-

sions and building site development. Board members are elected locally or appointed by the board of supervisors and a board may include an unlimited number of non-voting directors. RCD directors hold regular monthly business meetings and prioritize local resource conservation concerns via annual and long-range work plans. Although there is no mechanism in place for funding RCDs, several districts throughout California exercised their right to assess taxes before Proposition 13 passed. Several other RCDs around the state have entered into grant program agreements as a way to help fund conservation demonstration projects, land treatment programs and information and education activities.

Western Shasta RCD

The Western Shasta Resource Conservation District (WSRCD) was established in 1957, and extends north to Siskiyou County, west to Trinity County, south to Tehama County, and east essentially along the watershed divide between eastern and western Shasta County. It covers approximately 1,700,000 acres.

A board of seven directors governs the WSRCD. The County Board of Supervisors appoints RCD directors who serve voluntarily. They are local, private landowners who share a common interest in providing direction in their community's natural resource programs.

WSRCD can act as the "on-the-ground" implementing agency for restoration and conservation work by contracting with agencies. WSRCD also organizes Coordinated Resource Management Plans involving local landowners and government agencies. District activities include technical field assistance, urban development projects, environmental education and information programs, along with a variety of other services.

The district's mission is to work cooperatively with willing landowners and other organizations leading to conservation or restoration of desirable natural resources.

FOR FURTHER INFORMATION:

Western Shasta Resource Conservation District
3179 Bechelli Lane, Suite 110
Redding, CA 96002-2041
Phone: (530) 246-5252

Tehama County RCD

Tehama County Resource Conservation District (TCRCD) was created in 1987 when Cottonwood RCD, Lassen View RCD, and Corning RCD consolidated. Vina RCD, in southeastern Tehama County, decided to remain a separate district. Five directors govern TCRCD assisted by eight associate directors. The directors have held offices and been involved at the state and national level.

TCRCD promotes conservation and supports the existing watershed conservancies. The district is encouraging planning and implementation of programs in other watersheds. In addition, TCRCD has promoted resource education for youth by sponsoring resource days, science fairs, and other natural resource activities. TCRCD has also sponsored workshops and seminars on topics including holistic resource management and wildlife management.

FOR FURTHER INFORMATION:

Tehama County RCD
Natural Resources Conservation Service
2 Sutter Street, Suite D
Red Bluff, CA 96080
Phone: (530) 527-4231

Sutter County RCD

Sutter County Resource Conservation District advises individuals and public agencies in planning and applying conservation practices for protection, restoration, or development of land, water, and related natural resources. It is not a regulatory agency. Technical help is provided without charge and covers a range of resource management activities, including: irrigation systems, irrigation water management, wildlife habitat management, range management, conservation education, erosion control, soils interpretations, wetland habitat, vegetation plantings, and rice residue management.

Five directors administer the Sutter County RCD, serving without pay for a four-year term. Meetings are at 7 p.m. on the second Wednesday of each month at 1511-B Butte House Road in Yuba City. All meetings are open to the public.

FOR FURTHER INFORMATION:

Sutter County Resource Conservation District
1511-B Butte House Road
Yuba City, CA 95993
Phone: (530) 674-1461

Yolo County RCD

Active for over 40 years, Yolo County RCD administers grants for habitat restoration, workshops, public outreach, water and energy conservation, groundwater recharge, flood control, pesticide management, and blending wildlife habitat with recreational opportunities. They welcome new members and alliances, both with individuals and agencies.

FOR FURTHER INFORMATION:

Yolo County Resource Conservation District
221 West Court Street, Suite 8
Woodland, CA 95695
Phone: (530) 662-2037

Other Resource Conservation Districts

Other RCDs within the Sacramento River Conservation Area are:

- Vina RCD
- Glenn County
- Colusa County

Irrigation Districts

Nine irrigation districts lie partially within the proposed Conservation Area. Each has a unique history and organizational structure. The Glenn-Colusa Irrigation District, for example, has its roots in the formation of the Central Irrigation district under the Wright Act of 1887. Other districts depend on groundwater, or tailwater, from adjacent districts. In addition to the irrigation districts within the proposed Conservation Area, several are located outside of the Conservation Area but obtain water at Sacramento River diversions.

Levee and Reclamation Districts

The formation of reclamation districts was originally authorized in 1868 to facilitate reclamation of swamplands by building levees and drainage systems. The formation and regulation of reclamation districts is incorporated into the Water Code, Section 50000 and following. Today, the landowners within these districts support their operation, maintenance, and improvement. Reclamation Districts 70, 1660, and 1500 are responsible for the maintenance of a major portion of the Sacramento River Flood Control Project levees on the east side of the main river channel below Colusa. The Sacramento River West Side Levee District is responsible for maintenance of the west side of the levee along the Sacramento River from Colusa to Knights Landing. In areas where there are no reclamation or levee districts, DWR maintains the project levees. (See Figure 2-13).

Irrigation, levee, and reclamation district activities along the Sacramento River can relate to riparian habitat management in several ways. Unlined irrigation and drainage ditches and canals may provide sufficient water for the growth of riparian habitat in areas that might not otherwise support it. Ditch and levee maintenance practices may also affect riparian habitat. In some areas levee maintenance is carried out in a way that allows strips of riparian habitat to remain on levee berms; in other areas this is not the case. The siting of larger diversion structures along the Sacramento River may also have important implications for riparian habitat; structures requiring bank protection may inhibit the physical river processes which maintain riparian forest succession.

Appendix E contains the addresses of the levee and reclamation districts within the proposed Conservation Area.

STATE AGENCIES

Office of the Secretary for Resources

The Secretary for Resources directs the State Resources Agency, which functions as an “umbrella” agency, setting major resource policy for the state and overseeing programs of agency departments including the Department of Water Resources (DWR), Department of Fish and Game (DFG), and California Coastal Commission (CCC). The agency evaluates California Environmental Quality Act (CEQA) documents for consideration of existing state policy, programs and plans. It coordinates all state agency comments on applications for U.S. Army Corps of Engineers (USACE) permits. State conservancies, such as the California Coastal Conservancy and the Tahoe Conservancy, are also within the Agency.

The Agency provided funding for the development of the Upper Sacramento River Fisheries and Riparian Habitat Restoration Plan of 1989. It is also providing staff and funding support for development of the of the Sacramento River Riparian Habitat Conservation Area.

FOR FURTHER INFORMATION:

Office of the Secretary for Resources
The Resources Agency
1416 Ninth Street, Room 1311
Sacramento, CA 95814
Phone: (916) 653-5656

California Department of Fish and Game

The California Department of Fish and Game (DFG) is the principal California agency responsible for the protection, management, and enhancement of fish and wildlife and the habitats upon which they depend. DFG's mission is "to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public". The DFG is part of the Executive Branch of the California State Government, a department within the Resources Agency. DFG is governed by the Constitution and laws of the state, and policies of the Fish and Game Commission.

DFG has jurisdiction over, and responsibility for, all populations and habitats of birds, mammals, inland and anadromous fishes, amphibians, reptiles, and aquatic invertebrates within the Sacramento River Conservation Area, including the river channel and associated riparian areas. DFG conducts wide-ranging programs including research, environmental review and agreements, species and habitat restoration and management, public information and outreach, management of hunting and fishing, management of wildlife areas and ecological preserves, artificial propagation, and law enforcement. In addition, DFG promotes habitat restoration activities through various grants.

Programs and Policies

STREAMBED ALTERATION AGREEMENTS (SECTIONS 1600-1607 OF FISH AND GAME CODE)

Under the Fish and Game Code, DFG is responsible for review of any project which affects the natural flow, bed, channel, or bank of any river, stream, or lake in which there is, at any time, an existing fish or wildlife resource deriving benefit. Proponents of such projects generally must obtain a Stream or Lake Alteration Agreement under Sections 1601 (public project) and 1603 (private project) of the California Fish and Game Code. These agreements are usually initiated through the local DFG warden and will specify timing and construction conditions, including any mitigation necessary to protect fish and wildlife from impacts of the work.

The Sacramento River Conservation Area lies within two different DFG Regions. Region 1 includes both Shasta and Tehama Counties. Region 2 includes Butte, Glenn, Colusa, Sutter and Yolo Counties. Proponents should contact either the local DFG

warden or the Environmental Services Section in their region to develop a streambed alteration agreement.

CALIFORNIA ENDANGERED SPECIES ACT (SECTIONS 2050-2116 OF FISH AND GAME CODE) AND NATIVE PLANT PROTECTION ACT (SECTIONS 1900-1933 OF FISH AND GAME CODE):

DFG is responsible for administering the California Endangered Species Act (CESA) and Native Plant Protection Act (NPPA) which were enacted to prevent species from extinction. California law specifies that the decision for listing under CESA and NPPA be made by the California Fish and Game Commission. DFG is responsible for the initial listing of a species, monitoring, providing status reports, and developing and implementing recovery plans.

CALIFORNIA ENVIRONMENTAL QUALITY ACT

DFG also acts as the “lead agency” for DFG initiated projects, or trustee or “responsible agency” for non-DFG initiated projects, under the California Environmental Quality Act (CEQA). This means that DFG will either prepare a negative declaration or environmental impact report (EIR) for DFG initiated projects or will review and comment on such documents that other lead agencies prepare. DFG normally considers any impacts to riparian/wetlands habitat significant under CEQA, in addition to any other impacts that would have a potential for adverse effect on fish and wildlife resources or their habitat.

ESTABLISHMENT OF ECOLOGICAL RESERVES
(SECTIONS 1580-1585 OF FISH AND GAME CODE)

These sections of the Fish and Game Code establish state policy to protect threatened or endangered native plants, wildlife, or aquatic organisms or specialized habitat types, both terrestrial and aquatic, for the future human use, through the establishment of ecological reserves. DFG may, with approval of the Fish and Game Commission, acquire through purchase, lease, easement, gift, rental, memorandum of understanding or otherwise, land and water, or land and water rights for the purpose of establishing ecological reserves.

NATIVE SPECIES CONSERVATION AND ENHANCEMENT ACT
(SECTIONS 1750-1772 OF FISH AND GAME CODE)

This act establishes as state policy, the intent to maintain sufficient populations of all species of wildlife and native plants and the habitat necessary to insure their continued existence at optimum levels. The Act further declares the intent to provide for the beneficial use and enjoyment of wildlife and native plants by all citizens of the state, perpetuation of native plants and all species of wildlife for their intrinsic and ecological values and for their aesthetic, educational, and non-appropriative uses. The Act authorizes expenditures for DFG management activities, natural history, educational and recreational programs and acquisition of additional lands at designated areas.

SACRAMENTO-SAN JOAQUIN VALLEY WETLANDS MITIGATION BANK ACT OF 1993
(SECTIONS 1775-1796 OF THE FISH AND GAME CODE)

This Act recognizes that wetlands within the Sacramento-San Joaquin Valley provide significant value for migratory waterfowl, endangered species, other resident wildlife and fish populations, as well as such additional public benefits as water quality improvement, flood protection, stream bank stabilization, recreation, and scientific research. The intent of this Act is to establish a mechanism for establishing and operating mitigation banks to provide specific predefined sites within which credits may be purchased to mitigate for wetlands impacts.

SIGNIFICANT NATURAL AREAS PROGRAM
(SECTIONS 1930-1933 OF THE FISH AND GAME CODE)

This program is based upon state policy to encourage cooperative efforts to maintain the state's most significant natural areas. It implements the California Natural Diversity Data Base, designed to identify and document the state's most significant natural areas and encourage cooperative measures to maintain and perpetuate them.

WILDLIFE AND NATURAL AREAS CONSERVATION PROGRAM (PROPOSITION 70)
(SECTIONS 2700-2729 OF THE FISH AND GAME CODE)

This Act was passed to provide the Wildlife Conservation Board (WCB) and DFG the financial means to correct the most severe deficiencies in wildlife habitat and in the statewide system of areas designated for the preservation of California's natural diversity through a program of acquisition, enhancement, restoration, and protection of areas that are most in need of proper conservation.

KEENE-NIELSEN FISHERIES RESTORATION ACT OF 1985
(SECTIONS 2760-2765 OF THE FISH AND GAME CODE)

This Act is directed at reasonable efforts to prevent further declines in fish and wildlife, to restore fish and wildlife to historic levels where possible, and to enhance fish and wildlife resources where possible. The Act is particularly directed at implementing measures to protect, restore and enhance naturally spawning populations of salmon and steelhead.

CALIFORNIA WILDLIFE PROTECTION ACT OF 1990 (PROPOSITION 117)
(SECTIONS 2780-2799.6 OF THE FISH AND GAME CODE)

The Act directs the preservation, maintenance and enhancement of wildlife habitat, with particular emphasis on deer and mountain lion.

NATURAL COMMUNITY CONSERVATION PLANNING ACT (SECTION 2800-2840 OF THE FISH AND GAME CODE)

The Natural Community Conservation Planning Act (NCCP) provides for the implementation of a plan on a regional or area wide basis that protects and perpetuates natural wildlife diversity while allowing compatible and appropriate development and growth.

SALMON, STEELHEAD TROUT, AND ANADROMOUS FISHERIES RESTORATION PROGRAM
(SECTIONS 6900-6924 OF THE FISH AND GAME CODE)

This act establishes the goal of doubling the natural production of salmon and steel-

head trout by the end of the century, while encouraging public participation in mitigation, restoration and enhancement programs.

COMMERCIAL SALMON TROLLERS ENHANCEMENT AND RESTORATION PROGRAM
(SECTIONS 7860-7863 OF THE FISH AND GAME CODE)

This program implements projects to restore and enhance salmon habitat.

TAXES AND ASSESSMENTS - STATE OWNED PROPERTY
(SECTION 1504 OF FISH AND GAME CODE)

This section of the Fish and Game Code discusses reimbursement, assessments, and payments on state owned property. When income is derived from state owned property “the department shall pay annually to the county in which the property is located, an amount equal to the county taxes levied upon the property at the time title to the property was transferred to the state. The department shall also pay the assessments levied upon the property by any irrigation, drainage, or reclamation district.”

FOR FURTHER INFORMATION:

Shasta County	California Department of Fish and Game
Tehama County	Region 1 (Northern California-North Coast)
	601 Locust
	Redding, CA 98001
	Phone: (530) 225-2300
Butte County	California Department of Fish and Game
Glenn County	Region 2 (Sacramento Valley-Central Sierra)
Colusa County	1701 Nimbus Road
Sutter County	Rancho Cordova, CA 95870
Yolo County	Phone: (530) 358-2900

Fish and Game Commission

The Fish and Game Commission, consisting of five members appointed by the Governor, sets the policy under which DFG operates, and regulates the possession and taking of fish and wildlife. Fish and Game Commission policies, which directly relate to the implementation of a Sacramento River Riparian Conservation Area, include:

Policies

Land Use Planning

This policy states that the preservation, protection and restoration of fish and wildlife resources within the state is of significant public interest. It is inseparable from the need to acquire, preserve, protect and restore fish and wildlife habitat to the highest possible level, and to maintain, in a state of high productivity, those areas that can be most successfully used to sustain fish and wildlife and which will provide appropriate consumptive and non-consumptive public use.

Wetlands Resources

It is the policy of the Fish and Game Commission to seek to provide for the protection, preservation, restoration, enhancement, and expansion of wetland habitat in California.

Joint Policy on Hardwoods

The Fish and Game Commission and the State Board of Forestry find that the resources on hardwood rangelands and timberlands of California are a vitally important natural and economic resource. The hardwood resources of California should be managed for the long-term perpetuation of their local and broader geographic representation and to continue to provide for their inherent natural and biological values and processes.

Wildlife Conservation Board

The Wildlife Conservation Board (WCB) is composed of the President of the Fish and Game Commission, Director of DFG, the Director of the Department of Finance, and six legislative advisory members. It administers several programs and provides funding to support various policies within the Fish and Game Code. The Wildlife Conservation Board continues to be active in implementing projects to protect and restore the riparian corridor along the Sacramento River.

The WCB has the authority to acquire, restore, and enhance fish and wildlife habitat and to provide compatible public access facilities. It has acquired 3,615 acres of land along the Sacramento River designated as the Sacramento River Wildlife Area. The WCB has also acquired several other parcels upstream and downstream of the Wildlife Area by fee title, and conservation easements. DFG manages most of the land that WCB has acquired.

Using funding provided by the Fish and Wildlife Enhancement Act of 1984, a habitat conservation bond act, WCB sponsored the development of the Sacramento River Riparian Atlas (1988), a project which mapped and prioritized existing and potential riparian habitat sites along the river. This data supported acquisition efforts by WCB, The Nature Conservancy, and the USFWS.

The Wildlife Conservation Board created the Wildlife Conservation Law of 1947 (Sections 1300-1375 of the Fish and Game Code) to investigate, study and determine areas within the state that are most essential and suitable for wildlife production and preservation and which may be appropriate for compatible recreational development. The WCB approves and funds projects that set aside, restore, and enhance lands within the state for such purposes.

Programs

CALIFORNIA RIPARIAN HABITAT CONSERVATION PROGRAM
(SECTION 1385-1391 OF FISH AND GAME CODE)

The California Riparian Habitat Conservation Program (CRHCP) is directed to protect, preserve, and restore riparian habitats throughout the state and to coordinate its activities with DFG and with all state agencies and other governmental and nongovernmental organizations whose activities affect riparian habitats. The WCB uses available funding to acquire full or partial interest in land and to restore degraded

riparian areas. Under the authority provided with the CRHCP, the WCB is authorized to grant funds to federal, state, and local governmental agencies and to nonprofit conservation organizations to accomplish these goals. On a statewide basis since the CRHCP was authorized in 1992, WCB has funded 24 restoration projects involving private and public landowners, and acquired and protected more than 39,000 acres of riparian land. The CRHCP also coordinates on a regular basis with many agencies and statewide organizations to encourage ongoing efforts to protect and restore the state's rivers and riparian areas, including the California Rivers Assessment Project and the California Partners in Flight Riparian Habitat Joint Venture.

**INLAND WETLANDS CONSERVATION PROGRAM
(SECTIONS 1410 AND 1431 OF THE FISH AND GAME CODE)**

The Inland Wetlands Conservation Program is specifically directed at implementing the programs of the Central Valley Habitat Joint Venture (CVHJV), and is funded through the Inland Wetlands Conservation Fund with funds provided by the Habitat Conservation Fund. The Sacramento River Conservation Area, primarily from Red Bluff to the south, lies within the focus area of the CVHJV and the Inland Wetlands Conservation Program. The goal of the CVHJV is to protect, maintain and restore habitat to increase waterfowl populations in the Central Valley. Specifically, CVHJV seeks to protect existing wetlands and acquire additional wetlands through fee-title or perpetual conservation easements. In support of the CVHJV goals, the WCB may acquire or accept through gift or dedication, fee-title, easements, leases, development rights or other interests in appropriated lands. The WCB may also fund wetland habitat restoration projects on private or public land. The Inland Wetlands Conservation Program also administers a grant program to accomplish these goals, working with eligible government or non-governmental conservation organizations.

FOR FURTHER INFORMATION:

Wildlife Conservation Board
801 K Street, Suite 806
Sacramento, CA 95814
Phone: (916) 445-8448

Department of Water Resources

The Department of Water Resources (DWR) is responsible for formulating coordinated statewide plans for the control, conservation, protection, enhancement, and use of state water resources. DWR's mission is to evaluate current and projected needs for water and development programs; to direct the use of the resource; to protect the public through water quality improvement, flood control, and dam safety programs; and to assist local water agencies with funds, expertise, and technical support to improve their water delivery systems. DWR issues permits for activities involving dams or reservoirs.

DWR's Division of Flood Management is responsible for statewide flood protection, the assessment of the DWR's flood control needs with consideration to floodplain management, and the more traditional structural works. Along the Sacramento River, the division is responsible for maintaining specified portions of the Sacramento River.

Flood Control Project, including the main and overflow channels of the Sacramento River and its tributaries. This division is responsible for inspecting the Sacramento River Flood Control Project levees, to assess compliance with environmental easements adjacent to these levees. The Division also works as the state coordinating agency for the Federal Emergency Management Agency (FEMA).

DWR's Division of Local Assistance (Northern District) provides staff support to the Upper Sacramento River Fisheries and Riparian Habitat Management Program. This work includes the development of a Sacramento River Geographical Information System. In addition, the Division conducts studies related to the riparian ecosystem along the Sacramento River, including land use, riparian vegetation, erosion, and see page studies.

**FOR FURTHER INFORMATION ON DWR'S FLOOD MANAGEMENT ACTIVITIES
ALONG THE SACRAMENTO RIVER:**

California Department of Water Resources
Division of Flood Management
Floodplain Management Branch
1020 9th Street
Sacramento, CA 95814
Phone: (916) 574-2783

**FOR MORE INFORMATION ON THE SACRAMENTO RIVER GEOGRAPHICAL
INFORMATION SYSTEM:**

California Department of Water Resources
Division of Local Assistance
Northern District, Water Management Branch
2440 Main Street
Red Bluff, CA 96080
Phone: (530) 529-7300

Reclamation Board

Staffed by DWR, the Reclamation Board (the Board) is the state agency that cooperates with the USACE in controlling flooding along the Sacramento and San Joaquin Rivers and tributaries. The California Legislature created the Board in 1911 to carry out a comprehensive flood control plan for the Sacramento and San Joaquin Rivers. Under California law, no reclamation project may be started or carried out on or near the Sacramento and San Joaquin Rivers until the Board has approved plans for such work. The Board's efforts focus on controlling floodwater, reducing flood damage, protecting land from floodwater erosion that would affect project levees, and controlling encroachment into floodplains and onto flood control works, including levees, channels, and pumping plants.

The Board also establishes designated floodways in order to maintain channel capacity. The Board usually administers this regulation, but counties can administer it under an agreement with the Board. The Board owns and manages riparian habitat along the Sacramento River which serves a flood control purpose (often known as "MBK sites" after the firm, Murray, Burns and Kienlen which identified them) (Chapter 2). It has also purchased environmental easements along the river as mitigation for bank protection construction and general, as well as levee, maintenance activities.

FOR FURTHER INFORMATION:

The Reclamation Board
1416 Ninth Street
Sacramento, CA 95814
Phone: (916) 653-5434

Department of Parks and Recreation

California Department of Parks and Recreation's (DPR) mission is to provide for the health, inspiration, and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation.

DPR activities are directed toward accomplishing eight principal objectives: 1) secure and preserve elements of the state's outstanding landscape, cultural, and historical features; 2) provide the facilities and resources required to fulfill the recreational demands of the people of California; 3) provide a meaningful environment in which the people of California are given the opportunity to understand and appreciate the state's cultural, historical, and natural heritage; 4) maintain and improve the quality of California's environment; 5) prepare and maintain a statewide recreational plan that includes an analysis of the continuing need for recreational areas and facilities and a determination of the levels of public and private responsibility required to meet those needs; 6) encourage all levels of government and private enterprise throughout the state to participate in the planning, development, and operation of recreational facilities; 7) meet the recreational demands of a highly accelerated, urban-centered population growth, through the acquisition, development, and operation of urban parks; and 8) encourage volunteer services in the State Park System through the establishment of a recognition program of such services. DPR's resource management includes native plant reintroduction, exotic plant removal, prescribed fire management, and restoration of stream channels, banks, and associated riparian vegetation.

DPR is responsible for the disbursement of state bond funds and Federal Land and Water Conservation Funds (when such funds exist) and other grants to local government park and recreation agencies that contribute to the resource management of rivers and streams.

DPR owns and manages several sites along the Sacramento River (Chapter 7). These sites are managed according to the eight management principles discussed above.

FOR FURTHER INFORMATION:

California Department of Parks and Recreation
P.O. Box 942896
Sacramento, CA 94296-0001
Phone: (916) 653-7423

California Department of Parks and Recreation
Northern Buttes District
400 Glen Drive
Oroville, CA 95966-9222
Phone: (530) 538-2200

Department of Boating and Waterways

The Department of Boating and Waterways (DBW) is responsible at the state level for providing programs to develop recreational boating access and promote safety on California's waterways. To these ends, DBW provides programs to construct and improve small craft harbors and marinas, boat launching facilities, and boating facilities on state-owned lands. DBW's Beach Erosion Control Unit studies coastal sand supply and transport, which is related to the management of inland stream systems. Under the Recreational Trails Act of 1974 (Sections 5070 - 5076 of the Public Resources Code), DBW has planning responsibilities for the Boating Trails Element of the Recreational Trails Plan, including identifying non-motorized boating trail routes, and complementary facilities to be included within the system. The department publishes *A Boating Trail Guide to the Sacramento River*, *Woodson Bridge to Colusa* and *Safe Boating Hints for the Sacramento River*. A third publication, *A Boating Trail Guide to the Sacramento River, Redding to Red Bluff* is currently in production.

FOR FURTHER INFORMATION:

California Department of Boating and Waterways
1629 S Street
Sacramento, CA 95814
Phone: (916) 445-2615

California Water Commission

The California Water Commission serves as a policy advisory body to the Director of Water Resources on all California water resource matters. The nine-member citizen commission serves to coordinate state and local views with regard to federal appropriations for flood control, water, and fishery projects in California. It provides a water resources forum for the people of the state, acts as liaison between the legislative and executive branches of state government, and coordinates federal, state, and local water resources efforts. A member of the California Water Commission has participated in the SB1086 Advisory Council since its creation.

FOR FURTHER INFORMATION:

California Water Commission
1416 9th Street, Room 1148
Sacramento, CA 95814
Phone: (916) 653-5958

Office of Emergency Services

The Office of Emergency Services (OES) assists local governments in preparing for and responding to flooding and other disasters. It is often active along the Sacramento River during emergency flood events. OES also administers Hazard Mitigation funds, which can be applied to riparian corridor securement programs that provide demonstrated positive cost benefit ratios relative to flood management.

FOR FURTHER INFORMATION:

Office of Emergency Services
2800 Meadowview Road
Sacramento, CA 95832
Phone: (916) 262-1800

Department of Forestry and Fire Protection

The mission of the California Department of Forestry and Fire Protection (CDF) is to: 1) prevent and suppress fires occurring on state and privately owned forest, brush, and grass covered lands; 2) provide land management programs; 3) administer and enforce forest practice rules; 4) assist in range improvement programs; and 5) conduct or cooperate in forest and fire research programs.

When funds are available, CDF also administers various cost-share programs including the Forest Improvement Program, the Stewardship Incentive Program, the California Forest Improvement Program, and the Agricultural Conservation Program (Chapter 2). Some of these are applicable to riparian habitat conservation on the Sacramento River.

CDF plays an important role in fire protection along the Sacramento River. In addition, its activities in the forests of the surrounding watersheds may impact runoff amount and pattern into the Sacramento River. A CDF representative sits on the SB1086 Advisory Council.

FOR FURTHER INFORMATION:

Shasta County: California Department of Forestry and Fire Protection
Shasta Ranger Unit
1000 Cypress Avenue
Redding, CA 96001
Phone: (530) 225-2418

Tehama County: California Department of Forestry and Fire Protection
Glenn County: Tehama-Glenn Ranger Unit
604 Antelope Boulevard
Red Bluff, CA 96080
Phone: (530) 529-8548

Butte County: California Department of Forestry and Fire Protection
Butte Ranger Unit
176 Nelson Avenue
Oroville, CA 95965
Phone: (530) 538-7111

Colusa County: California Department of Forestry and Fire Protection
Yolo County: Sonoma-Lake-Napa Ranger Unit
1572 Railroad Avenue
St. Helena, CA 94574
Phone: (707) 963-3601

Regional Water Quality Control Board

The Regional Water Quality Control Board (Regional Board) acts locally for the State Water Quality Control Board. Its role is to protect surface and groundwater quality and the beneficial uses of the waters throughout the region by: 1) issuing waste discharge requirements (permits) regulating the discharge of waste to surface water and groundwater; 2) enforcement of waste discharge requirements by issuing cease and desist orders, cleanup and abatement orders, administrative civil liability orders, and court action; 3) water quality control planning within the region; and 4) surveillance and monitoring to detect new sources of pollution and to ensure that ongoing discharges are in compliance with waste discharge requirements.

The primary historical relationship between the Regional Board and landowners along the Sacramento River, has been through Section 401 of the Clean Water Act. Under this law, applicants for a permit from the U.S. Army Corps of Engineers (pages 35-36) for discharge of dredge or fill material must also obtain a "Water Quality Certification" that the project will uphold state water quality standards. Applicants for this certification are required to submit an application with the appropriate fee to the Executive Officer of the Regional Board. Upon receipt of a complete application, the Regional Board staff will determine if waiver, certification, or denial of certification will be recommended. California Environmental Quality Act (CEQA) compliance is required prior to board action.

In addition to these regulatory responsibilities, the Central Valley Regional Water Quality Control Board is administering the Sacramento River Watershed Program (funded by the Environmental Protection Agency). The goal of this program is to ensure that the current and potential uses of the Sacramento River watershed's resources are sustained, restored, and where possible, enhanced, while promoting the long-term social and economic vitality of the region.

FOR INFORMATION ON OBTAINING WATER QUALITY CERTIFICATION IN CONNECTION WITH A U.S. ARMY CORPS 404 PERMIT:

Shasta, Tehama and Glenn Counties:	Central Valley Regional Water Quality Control Board Redding Office 415 Knollcrest Drive Redding, CA 96002 Phone: (530) 224-4845
---------------------------------------	---

Butte, Colusa, Sutter and Yolo Counties:	Central Valley Regional Water Quality Control Board 3443 Routier Road Sacramento, CA 95827-3098 Phone: (916) 225-3000
---	--

FOR INFORMATION ON THE SACRAMENTO RIVER WATERSHED PROGRAM:

Central Valley Regional Water Quality Control Board
3443 Routier Road, Suite A
Sacramento, CA 95827-3098
Phone: (916) 255-3000

State Lands Commission

The Commission administers state-owned “sovereign lands”. Sovereign lands, those underlying tidal and navigable waterways, encompass nearly 4 million acres of lakes, rivers, sloughs, and bays, as well as state ocean waters. Examples of sovereign lands include the California portion of Lake Tahoe, San Francisco Bay, most Delta waterways, the San Joaquin and Sacramento Rivers, and the three-mile strip of tide and submerged lands along the entire California coastline.

Under the Public Trust Doctrine, sovereign lands are held for the benefit of all the people of the State for public trust purposes of waterborne commerce, navigation, fisheries, open space, recreations, and habitat preservation, among others.

The Lieutenant Governor, the State Controller and the State Director of Finance serve as ex-officio members of the Commission. A staff of more than 220 specialists in land management, mineral resources, boundary determination, petroleum engineering, and the natural sciences assist the Commission.

The Upper Sacramento River, defined by this *Handbook* as between Keswick Dam and the mouth of the Feather River, as well as some portions of the larger tributaries in this area, are state-owned sovereign lands. These particular waterways are regarded as non-tidal and therefore California holds a fee ownership in the bed of the river or stream between the ordinary low water marks. The entire river or stream between the ordinary high water marks is subject to a Public Trust Easement. (In tidal waterways, the State generally owns in fee to the ordinary high water mark, as in, for example, the tidal portions of the Sacramento River in its downstream reaches.)

Because the landward boundaries of the State’s sovereign interests are generally based upon the ordinary high water marks as they last naturally existed, boundaries may not be readily apparent from observing present day conditions.

Both easement and fee-owned lands are under Commission jurisdiction as land owner and manager. Proposed development projects on state-owned lands or other projects seeking to occupy sovereign lands for a variety of uses normally require Commission authorization. On fee-owned state lands, public and private entities may apply to the Commission for leases or permits for a variety of purposes including marinas, boat launches, private docks, pipeline crossings, dredging, or fish and wildlife refuges.

In its day-to-day role as trust land manager, the Commission seeks to balance resource management, revenue generation, environmental protection, and public enjoyment on sovereign state lands. The Commission must carry out its responsibilities under the Public Trust Doctrine as well as a number of other laws and regulations which govern its operation, including the California Environmental Quality Act (CEQA).

The Commission recently published *California’s Rivers: A Public Trust Report*, a 334 page report on the status and trends of the states rivers, including their values, ecology, and history. A representative of the Commission sits on the SB1086 Advisory Council.

FOR FURTHER INFORMATION:

California State Lands Commission
100 Howe Avenue, Suite 100
Sacramento, CA 95825
Phone: (916) 574-1900

FEDERAL AGENCIES

United States Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) is the principal agency through which the federal government carries out its responsibilities to conserve, protect, and enhance the nation's fish and wildlife and their habitats. The agency's major responsibilities are for migratory birds, and candidate, threatened and endangered species. The USFWS is both a regulatory agency with jurisdiction over both public and private lands and a land management agency for federal wildlife refuges.

USFWS's programs include fish and wildlife conservation; technical and financial assistance on fish and wildlife management to the private sector, federal, state, and local agencies. Migratory birds; the acquisition of areas for management and protection of migratory birds, endangered species, and other wildlife, and for wildlife-oriented public recreation; wetlands conservation; funding for wetlands acquisition; wetland delineation; assessing the affects of contaminants on wildlife and their habitats; conservation of estuarine areas under the Estuarine Areas Act (PL 90-454); the National Wetland Inventory and insuring compliance with NEPA.

In accordance with the Fish and Wildlife Coordination Act, the USFWS reviews projects which are funded by the federal government or require a federal permit. The Clean Water Act gives the USFWS the authority to review dredge and fill permits administered by the U.S. Army Corps of Engineers in waters of the U.S. (Section 404 and Section 10). The USFWS reviews hydroelectric power projects under the authority of the Federal Power Act, and also provides consultation on endangered species for the environmental review processes under the Endangered Species Act, National Environmental Policy Act (NEPA), and the California Environmental Quality Act (CEQA).

Endangered Species Act

The USFWS implements various provisions of the Endangered Species Act (ESA): species listing, consultations and permits for possible "incidental takes" of listed species, and oversight and approval of Habitat Conservation Plans. The act provides for the establishment of lists of threatened and endangered species. Any inclusions to or deletions from the lists must come after proper notice and, if requested, public hearing. The lists are reviewed every five years to determine if any species should be removed or have their status changed.

The Secretary of the Interior may also identify critical habitat and impose regulations governing those areas. The Secretary of the Interior is also directed to establish programs for the conservation and recovery of listed species, including the acquisition of land and other interests affecting habitat.

Migratory Bird Conservation Act

Under the Migratory Bird Conservation Act of 1929, the USFWS is authorized to acquire lands for conservation of migratory waterfowl. The agency can also purchase land for refuges under the Fish and Wildlife Act of 1956, the Endangered Species Act of 1973, and the Emergency Wetlands Resources Act of 1986. In northern California, the FWS manages the Klamath Basin, Modoc, Sacramento, San Francisco Bay, Stone Lakes, and Humboldt Bay National Wildlife Refuges.

Other Programs

The USFWS has also been actively involved in the conservation and restoration of riparian habitat along the Sacramento River through the Private Lands Program established in 1989 and its ongoing acquisition and management of the Sacramento River National Wildlife Refuge and the private lands program established in 1989. The agency also has an interest in the conservation and restoration of riparian habitat because of its role in identifying and protecting habitat of federal trust resource species. For example, the Service has identified shaded riverine aquatic habitat as critical habitat for migratory juvenile winter run salmon. A USFWS representative is on the SB1086 Advisory Council.

Central Valley Project Improvement Act

In collaboration with the Bureau of Reclamation, the Service administers the Central Valley Project Improvement Act of 1992. The Act provides for the implementation of activities to protect, restore, and enhance fish, wildlife and associated habitats in the Central Valley and Trinity River Basins.

FOR FURTHER INFORMATION ON THE SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX:

U.S. Fish and Wildlife Service
Sacramento River National Wildlife Refuge
752 County Road 99W
Willows, CA 95988
Phone: (530) 934-2801

FOR FURTHER INFORMATION REGARDING WILDLIFE AND FISHERIES ISSUES ALONG THE SACRAMENTO RIVER:

U.S. Fish and Wildlife Service
Sacramento Field Office
2800 Cottage Way, W-2605
Sacramento, CA 95825
Phone: (916) 414-6600

United States Bureau of Reclamation

The Bureau of Reclamation (USBR) is an agency of the Department of the Interior. Its mission is to manage, develop, and protect water and water-related resources in an environmentally and economically sound manner in the interest of the American public. As part of its responsibilities, the USBR provides states or state entities with technical assistance on projects already underway, consistent with the state's needs and the USBR's capability.

The USBR constructs and maintains federal water development and reclamation projects, including those along the Colorado River and the Central Valley Project (CVP). It provides water for irrigation, municipal and industrial use, hydro-electric power generation, water quality improvement, wind power, fish and wildlife enhancement, outdoor recreation, river regulation, and flood control. The USBR plays a major role on the more significant river systems and a lesser role on their tributaries.

The Central Valley Project Improvement Act requires the USBR to put environmental uses of CVP water on an even footing with urban and agricultural consumptive uses, and also guarantees minimum quantities for fishery protection under specified circumstances.

The USBR supplies water to 3.8 million acres in California. Activities include the Central Valley Project, (including Shasta, Clair Engle, Whiskeytown, New Melones, Folsom, San Luis, and Millerton lakes) and major canals and hydroelectric facilities (the All-American Canal system in the Imperial Valley and the Parker, Davis, Cachuma, Klamath, Orland, San Diego, Solano, Truckee Storage, Ventura River, Santa Maria, and Washoe projects).

The USBR is signatory to the Coordinated Operating Agreement between the CVP and the State Water Project (SWP) (1986), which provides that both the CVP and SWP are subject to water quality standards and export decisions taken from the State Water Resources Control Board (SWRCB) Water Rights Decision 1485. This provides for CVP/SWP proportional splits of 75/25 responsibility for meeting in basin use from stored water releases and 55/45 for capture and export of excess flow. It also requires a commitment of about 2.3 million acre-feet from both projects during a critical water supply period.

USBR operates both Shasta and Keswick Dams and therefore plays a key role in the regeneration and Health of the riparian forest downstream. It also operates the Whiskeytown Dam on Clear Creek and East Park and Stony Gorge Reservoirs on Stony Creek. USBR also operates Red Bluff Diversion Dam which is the diversion point into the Tehama-Colusa and Corning Canals, which irrigate the west side of the Sacramento Valley.

FOR FURTHER INFORMATION:

U.S. Bureau of Reclamation
Mid Pacific Region
Northern California Area Office
16349 Shasta Dam Boulevard
Shasta Lake, CA 96019
Phone: (530) 275-1554

United States Bureau of Land Management

The Bureau of Land Management (BLM) is a federal agency within the United States Department of the Interior responsible for the management of public lands and resources. BLM manages California's "public domain." Public domain includes all of the unsold federal lands within the state which are not withdrawn or reserved for some other federal purpose (e.g., Department of Defense, National Forests, National Parks and Monuments, Strategic Petroleum Reserve, Water Project, etc.) While the majority of BLM lands are in the southern California deserts, public lands exist throughout the state.

BLM management is based upon the principles of multiple-use and sustained yield, which strives to balance the nation's short-term needs with the long-term needs of future generations for renewable and non-renewable resources. The Federal Land Policy and Management Act of 1976 gives the BLM authority to establish policy and guidelines for the management, protection, development, and enhancement of pub-

lic lands that it manages. The Federal Land Policy & Management Act of 1976 requires BLM to manage public lands for multiple uses, including recreation, wilderness, animal and plant species, grazing, mining, and alternative energy. The Act authorizes the use of Areas of Critical Environmental Concern (ACEC) to protect and prevent irreparable damage to important historic, cultural, and scenic values; fish or wildlife resources; other natural systems or processes; or to protect human life and safety from natural hazards.

Much of BLM's jurisdictional area encompasses rivers and streams with substantial recreational and ecological value. BLM manages the riparian areas along those streams which flow through its jurisdictional area as part of its mandate to provide for multiple use of its resources. BLM recently completed a Riparian/Wetland Statewide strategy that calls for interdisciplinary planning, on-the-ground improvements of wetland/riparian areas, monitoring, out-reach efforts, and expanding work with partners and volunteers to restore and enhance wetland/riparian areas.

BLM is consolidating public land parcels through land exchanges and Land and Water Conservation Fund purchases in order to improve management of riparian areas along rivers. BLM is also involved in Challenge Cost Share programs with environmental groups, private organizations, and other government agencies.

BLM is developing cooperative agreements with farmers and cattle ranchers to help protect riparian areas. It has revised its grazing management plans to reduce overgrazing near sensitive stream and river banks and to increase monitoring. With the help of volunteers, BLM has been fencing riparian areas in order to provide appropriate livestock grazing prescriptions, rehabilitating closed roads, and restoring native plant species along river banks.

BLM takes part in the Coordinated Resource Management Planning (CRMP) process, a collaborative public-private project planning and implementation process which seeks to involve all interested parties in management and restoration decisions and in project implementation. CRMP projects include innovative bank restoration projects and restoration of riparian habitat. BLM is also participating in bioregional planning and management efforts.

BLM owns and manages the Sacramento River Area in Tehama County, as described in Chapter 7. This land was acquired to protect riparian and wetland resources in the northern Sacramento Valley, to enhance anadromous fisheries and to provide recreational opportunities. BLM also owns other scattered parcels along the river, including Todd and Foster Islands in Tehama County.

FOR FURTHER INFORMATION:

Bureau of Land Management
355 Hemsted Drive
Redding, CA 96002-0910
Phone: (530) 224-2100

United States Geologic Survey

The USGS provides geologic, topographic, and hydrologic information that contributes to the management of resources. USGS collects data on a routine basis to determine quantity, quality, and use of surface and groundwater; conducts water resources appraisals describing the consequences of alternative plans for developing land and water resources; researches hydraulics and hydrology; and coordinates all federal water data acquisition.

The U.S. Geologic Survey has studied many issues along the river related to geomorphology and geology and has completed the most comprehensive description of the geology of the area. The agency also operates a network of streamflow gaging stations on the Sacramento River and its tributaries.

FOR FURTHER INFORMATION:

For USGS quadrangle sheets of the Sacramento River and for information regarding digital map information, contact:

U.S. Geologic Survey
Earth Science Information Center
345 Middlefield Road, MS 532
Menlo Park, CA 94025-3591
Phone: (415) 329-4309

United States Army Corps of Engineers

The mission of the United States Army Corps of Engineers (USACE) is twofold: 1) to provide engineering expertise and oversight for military and certain non-military construction and public works projects; and 2) to ensure the navigability and environmental protection of the waters of the United States. The USACE is the principal federal agency involved in the regulation of wetlands; however, the Environmental Protection Agency (EPA) has oversight responsibilities.

Civil Works

The COE carries on an extensive civil works (water resources development) program, including the planning, design, construction and operation of flood control and navigation projects, levee systems, and shoreline erosion control works. Much of its work, with respect to inland waterways during the past half century, has been engineered flood control facilities and the creation and maintenance of navigable shipping channels. The Sacramento River Flood Control Project (SRFCP) falls under USACE authority (Chapter 2).

Environmental Protection

Since 1890, the Corps has regulated activities in the nation's waterways, primarily to remove obstructions and ensure navigability for commerce and recreation. Starting in the late 1960s, this regulatory role broadened to include consideration and protection of the environmental values of waters of the United States.

Under Section 404 of the Clean Water Act (CWA) of 1974, the USACE regulates the discharge of dredged or fill material into waters of the United States, including wetlands.

Waters of the United States include essentially all surface waters such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. "Wetlands" are areas characterized by growth of wetland vegetation (bulrush, cattails, rushes, sedges, willows, pickleweed, iodine bush, etc.) where the soil is saturated during a portion of the growing season or the surface is flooded during some part of most years. Wetlands include marshes, vernal pools, seasonally saturated depressions and similar areas.

Prior to issuance of a Section 404 permit, the permittee must receive Section 401 water quality certification or a waiver of certification from the California Regional Water Quality Control Board. The Board issues 401 certification for activities that comply with all pertinent water quality standards.

The USACE also administers Section 10 of the Rivers and Harbors Act of 1899 which requires approval prior to the accomplishment of any work in or over navigable waters of the United States, or which affects the course, location, condition, or capacity of such waters. Typical activities requiring Section 10 permits are: construction of piers, wharves, bulkheads, dolphins, marinas, ramps, floats, intake structures, and cable or pipeline crossing, dredging, and excavation. Under Section 10, the landward regulatory limit for non-tidal waters (in the absence of adjacent wetlands) is the ordinary high water mark. The ordinary high water mark is the line on the shores established by the fluctuations of water and indicated by physical characteristics such as a clear natural line impressed on the bank; shelving; changes in the character of the soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas.

Any person, firm, or agency (including governmental agencies) planning to work in navigable waters of the United States, or to place dredged or fill material in waters of the United States, must first obtain a USACE permit.

FOR INFORMATION ON THE SACRAMENTO RIVER FLOOD CONTROL PROJECT, OR REGARDING RIPARIAN HABITAT ISSUES ALONG THE SACRAMENTO RIVER:

U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922
Phone: (916) 557-6708

FOR INFORMATION REGARDING SECTION 404 PERMITS:

U.S. Army Corps of Engineers
Sacramento District
Regulatory Branch
1325 J Street, Room 1480
Sacramento, CA 95814-2922
Phone: (916) 557-5268

United States Natural Resource Conservation Service

The mission of the Natural Resource Conservation Service (NRCS) is to provide national leadership in the conservation, development, and productive use of the nations soil, water and related resources through a balanced, cooperative program that protects, restores and improves those resources. Formerly known as the Soil Conservation Service, the NRCS provides technical assistance in the conservation and sustained use of the nations soil, water, air, plant, and animal resources through partnerships with local Resource Conservation Districts, state and federal Conservation Agencies, farm organizations, private interest groups, and other special districts. In addition, NRCS develops conservation plans for private landowners, makes recommendations on the installation of conservation practices, provides engineering survey and design information, conducts and publishes soils surveys and is responsible for maintaining National Resource Inventory information.

NRCS administers the conservation provisions of the 1985, 1990 and 1996 Farm Bills and makes highly erodible land and wetland determinations as they relate to growers participation in USDA subsidy programs. NRCS also administers the Wetland Reserve Program (WRP), Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentives Program (WHIP), PL-566 Small Watersheds Program and provides technical assistance for the Conservation Reserve Program (CRP) and the Emergency Watershed Protection (EWP).

FOR FURTHER INFORMATION:

Shasta County:

Natural Resources Cons. Service
3179 Bechelli Lane, Suite 107
Redding, CA 96002-2041
Phone: (530) 246-5252

Glenn County:

Natural Resources Cons. Service
132-B North Enright
Willows, CA 95988
Phone: (530) 934-4601

Tehama County:

Natural Resources Cons. Service
#2 Sutter Street, Suite D
Red Bluff, CA 96080
Phone: (530) 527-4231

Colusa County:

Natural Resources Cons. Service
100 Sunrise Boulevard, Suite B
Colusa, CA 95932
Phone: (530) 458-2931

Butte County:

Natural Resources Cons. Service
Soil Survey Office, CSUC
Chico, CA 95926-0310
Phone: (530) 898-4903

Sutter County:

Natural Resource Cons. Service
1511 Butte House Road, Suite B
Yuba City, CA 95993
Phone: (530) 674-1461

Yolo County:

Natural Resource Conservation Service
221 West Court Street, Suite 1
Woodland, CA 95695
Phone: (530) 662-2037

United States Forest Service

The United States Forest Service (USFS) manages approximately 20 million acres of National Forest lands, about 20 percent of the land in California. By law, National

Forest resources are managed for many uses including water supply and watershed protection, timber, range, fishery and wildlife habitat, and recreation. About 50 percent of the water supply in California originates in watersheds within national forests and the headwaters of most rivers and streams are found in national forests.

Approximately 1,000 miles of federally designated Wild and Scenic Rivers originate or pass through one or more national forest. Some 3.9 million acres have been set aside as Wilderness under the Wilderness Act of 1964.

Management of riparian and aquatic resources in National Forests is guided by standards and guidelines found in individual Forest Land and Resource Management Plans, as well as national environmental legislation such as the Clean Water Act, the Clean Air Act, and the Endangered Species Act. All National Forests use a special management designation for riparian areas (Streamside Management Zone) and land management activities that affect the riparian area may be modified or curtailed when impacts to riparian resources are anticipated. Wildlife management on the forests is conducted in cooperation with the California Department of Fish and Game (DFG).

The U.S. Forest Service owns the Lake Red Bluff Recreation Area in Red Bluff. This 488-acres site includes two boat launching facilities, camping and picnicking areas, and paved trails. Several riparian habitat restoration projects are on the site, which also houses the Sacramento River Discovery Center.

FOR FURTHER INFORMATION:

U.S. Forest Service
Red Bluff Recreation Area
1000 Sale Lane
Red Bluff, CA 96080
Phone: (530) 527-2813

National Marine Fisheries Service

The mission of the National Marine Fisheries Service (NMFS) is to conserve, manage, and develop living marine resources and to promote the continued use of these resources for the nation's benefit. Although NMFS jurisdiction and management activities are primarily confined to the coastal zone and its network of estuaries, the agency also is an advocate of measures to protect the health of salmon and other anadromous species. Together with eight Regional Fishery Management Councils and the coastal states, NMFS manages U.S. fisheries under the authority of the Magnuson Fishery Conservation and Management Act, the Fish and Wildlife Coordination Act, and many other federal statutes. Together with the states and the U.S. Coast Guard, NMFS also operates a stringent program to enforce fisheries and protected species laws.

Each NMFS Regional Office is served by a Science and Research Center that conducts the studies necessary to support management decisions. Research that contributes to this important work is conducted at the 24 NMFS laboratories which collect fisheries statistics, perform resource and environmental surveys, study the biology and population structures of marine species, analyze the ecosystems that control the abundance and distribution of living marine resources, and investigate contaminants of the nation's seafood supply.

NMFS serves as a caretaker for many marine species protected under the Endangered Species Act, including stocks of Pacific salmon. NMFS works to recover these depleted resources, protecting species from activities that threaten their safety and critical habitat.

The National Marine Fisheries Service works along the Sacramento River because of its interest in anadromous fish, such as steelhead and winter, spring and fall run salmon.

FOR FURTHER INFORMATION:

National Marine Fisheries Service
777 Sonoma Avenue, Room 325
Santa Rosa, CA 95404
Phone: (707) 575-6052

United States Environmental Protection Agency

The Environmental Protection Agency (EPA) was established in 1970 to protect, maintain, restore, and enhance environmental quality and human health through the regulation of activities that have potentially harmful effects on air, water, and land resources. The EPA is charged with protecting the environment through pollution prevention, reduction, remediation, and education. In so doing, it is the EPA's expressed intent to use the best available scientific information to: 1) foster the integration of economic development and environmental protection so that economic growth can be sustained over the long-term; and 2) to ensure that decisions affecting energy, transportation, agriculture, industry, international trade, and natural resources fully include considerations of environmental quality.

The EPA exercises authority through the National Pollution Discharge Elimination System (NPDES), National Pretreatment Program, Ocean Dumping/Dredging and Fill, and has delegated to states the authority to certify that permitted actions are consistent with the state's water quality objectives under the Clean Water Act. While the EPA is responsible for the administration of the Clean Water Act, management of water pollution control generally is the responsibility of the states.

Section 402 of the Clean Water Act requires EPA to establish regulations setting forth a program of NPDES permits for effluent discharges from point sources of pollution to surface waters. Point sources include municipal storm water management systems, manufacturing plant effluent, sewage treatment plants and storm water runoff from certain industrial and construction sites. NPDES permit programs are delegated to the states once the EPA has approved the State permitting process. The EPA retains oversight and authority, however, to object to individual permits when deemed necessary for water quality protection.

The EPA also has responsibilities under Section 404 of the Clean Water Act. This section regulates the discharge of dredged and fill material to waters of the United States. The EPA reviews and comments on public notices and pre-discharge notification for individual and nationwide permits, respectively. EPA and the U.S. Army Corps of Engineers have independent enforcement authority under Section 404.

The U.S. Environmental Protection Agency is involved in enforcing 404 permits along the Sacramento River, as well as administering grants through its 319 and other grant

programs. In addition to its regulatory responsibilities, the EPA provides technical assistance, conducts educational activities, and provides grant funding to state and local governments for a variety of pollution prevention and reduction activities in the watershed.

FOR FURTHER INFORMATION:

United States Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901
Phone: (916) 744-1300

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) provides flood insurance to jurisdictions that meet the criteria for participation in its program. The program was initiated to encourage better floodplain management and reduce damages in flood-prone areas. To identify flood-prone areas, FEMA requires delineation of a 100-year floodplain, which is then subject to regulation. In developed or developing areas, FEMA also identifies a part of the floodplain called the “floodway” that is subject to extreme limitations on development. In general, structural developments are prohibited in the floodway. The floodway is technically defined as the portion of the floodplain which is required to convey the 100-year peak flow with no more than a one-foot increase in the computed water surface elevation. Development is generally allowed outside of the floodway, although purchase of flood insurance is generally required.

FEMA also administers emergency public assistance under the Stafford Act. The FEMA public assistance program will fund emergency repairs to damaged, publicly maintained bank protection along the Sacramento River.

Much of the Sacramento River Conservation Area falls within the 100-year floodplain as defined by FEMA. The Conservation Area also includes many areas that FEMA designates as floodways.

FOR FURTHER INFORMATION:

Federal Emergency Management Agency
Region IX
Presidio, Building 105
San Francisco, CA 94129
Phone: (415) 923-7177

FLOOD INSURANCE:

NFIP (Region IX)
Computer Sciences Corporation
5777 Madison Avenue, Suite 810
Sacramento, CA 95841
Phone: (916) 334-1720

ORDERING MAPS (FLOOD MAP DISTRIBUTION CENTER):

1-800-358-9616

PRIVATE ORGANIZATIONS

California Central Valley Flood Control Association

The nonprofit California Central Valley Flood Control Association was formed in 1926 to promote the common interest in maintaining effective flood control systems for protection of life, property, and environmental values. The purposes of the organization include promoting awareness and distributing of information on flood-related issues and promoting effective flood control systems at the state and federal levels. Members include reclamation, flood control, levee, drainage, protective and similar districts, political subdivisions, public corporations, owners of record, nonprofit organizations and other persons, corporations, or organizations.

FOR FURTHER INFORMATION:

California Central Valley Flood Control Association
910 K Street, Suite 310
Sacramento, CA 95814
Phone: (916) 446-0197

Sacramento River Discovery Center

Opened in 1996, the Sacramento River Discovery Center provides information to the public about the river, its dynamic nature, the history of its development by humans, and methods for improving the health of its ecosystem. Its mission is to promote an understanding of the many uses of the Sacramento River. The center provides school children and adults with the opportunity to view fish, native plants and communities of flora and fauna endemic to the Sacramento riverine system. The center is located on U.S. Forest Service property on the Sacramento River near Red Bluff. The many acres of living classroom provide visitors to the center with a sense of the various uses of the river. Currently housed in a temporary facility, the ultimate goal of the Sacramento River Discovery Center is to open a 20,000 square foot building that will house an interpretive center as well as an education and research facility. The Discovery Center is a non-profit tax exempt organization, managed by a board of directors, interns, and volunteers.

FOR FURTHER INFORMATION:

Sacramento River Discovery Center
P.O. Box 1298
Red Bluff, CA 96080
Phone: (530) 527-1196

Sacramento River Preservation Trust

Founded in the 1984 in response to the Chico Landing to Red Bluff bank stabilization project, The Sacramento River Preservation Trust is a nonprofit organization devoted to the preservation and rehabilitation of the riparian system which exists along the Sacramento River Corridor.

The Trust is currently concerned primarily with educating the public and retaining constant awareness of the policies and regulations that may impact the Sacramento River and her environment. The Trust is a membership based non-profit, tax-exempt organization.

FOR FURTHER INFORMATION:

Sacramento River Preservation Trust
P.O. Box 5366
Chico, CA 95927
Phone: (530) 345-1865

Sacramento Valley Landowners Association

The Sacramento Valley Landowners Association consists of farmers and allied groups concerned with maintaining flood control facilities promoting bank protection, supporting agricultural endeavors, and representing the membership's concerns at meetings and forums. SVLA members own or control more than 100 miles of river frontage and farm almost 100,000 acres. SVLA supports river management and flood protection that is economically sound and ecologically reasonable.

FOR FURTHER INFORMATION:

Sacramento Valley Landowners Association
P.O. Box 879
Los Molinos, CA 96055
Phone: (916) 384-0161

Recommended Actions

Several actions are needed to carry out the goals of the *Upper Sacramento River Fisheries and Riparian Habitat Management Plan* (Resources Agency, 1989), and the plans described in this Handbook. These actions are:

- **Form a locally-based nonprofit management organization**
-----*In May, 2000 the Sacramento River Conservation Area, a nonprofit public benefit corporation was formed*
- **Obtain a signed Memorandum of Agreement (MOA) between the appropriate agencies**
-----*A MOA has been signed by most of the key agencies and all the named counties*
- **Develop site-specific plans and contracts, which may include the following features:**
 - conservation easements
 - set-aside agreements
 - bank protection
 - land acquisition from willing sellers
 - landowner protections
 - floodplain management strategies
- **Develop program to improve permit and regulatory coordination and consistency**
- **Develop mutual assistance program**
- **Develop education and outreach program**
- **Support monitoring and research programs**

This chapter provides a brief outline of these actions. They will be carried out in a manner that:

- Uses an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Participation by private landowners and affected local entities is voluntary, never mandatory;

- Gives full consideration to landowner, public, and local government concerns;
- Provides for the accurate and accessible information and education that is essential to sound resource management.

Form a locally-based Nonprofit Management Organization

The Nonprofit Organization, Sacramento River Conservation Area Forum (SRCAF), has been created as a California Corporation, filed its papers with the Internal Revenue Service as a 501 c-3 not-for-profit entity and began meeting in May of 2000. This entity is governed by a board of directors which includes both private landowner and public interest representatives from each of the involved counties, as well as ex-officio members from six state and federal resource agencies. A Technical Advisory Committee (TAC) composed of agency and academic scientists, as well as private individuals, has been established to advise the SRCA on issues related to river management and site-specific planning.

Obtain a signed Memorandum of Agreement between the appropriate agencies

To date, nineteen agencies, including the seven counties within the Conservation Area, have signed the MOA.. The MOA signatories are as follows: The Resources Agency, California Department of Fish and Game, California State Parks and Recreation, Wildlife Conservation Board, U.S. Army Corps of Engineers, State Lands Commission, U.S. Bureau of Land Management, Glenn County, Butte County, Shasta County, Colusa County, Tehama County, Sutter County, Yolo County, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, The Reclamation Board, Department of Water Resources, and California Department of Food and Agriculture.

Develop site-specific plans and contracts

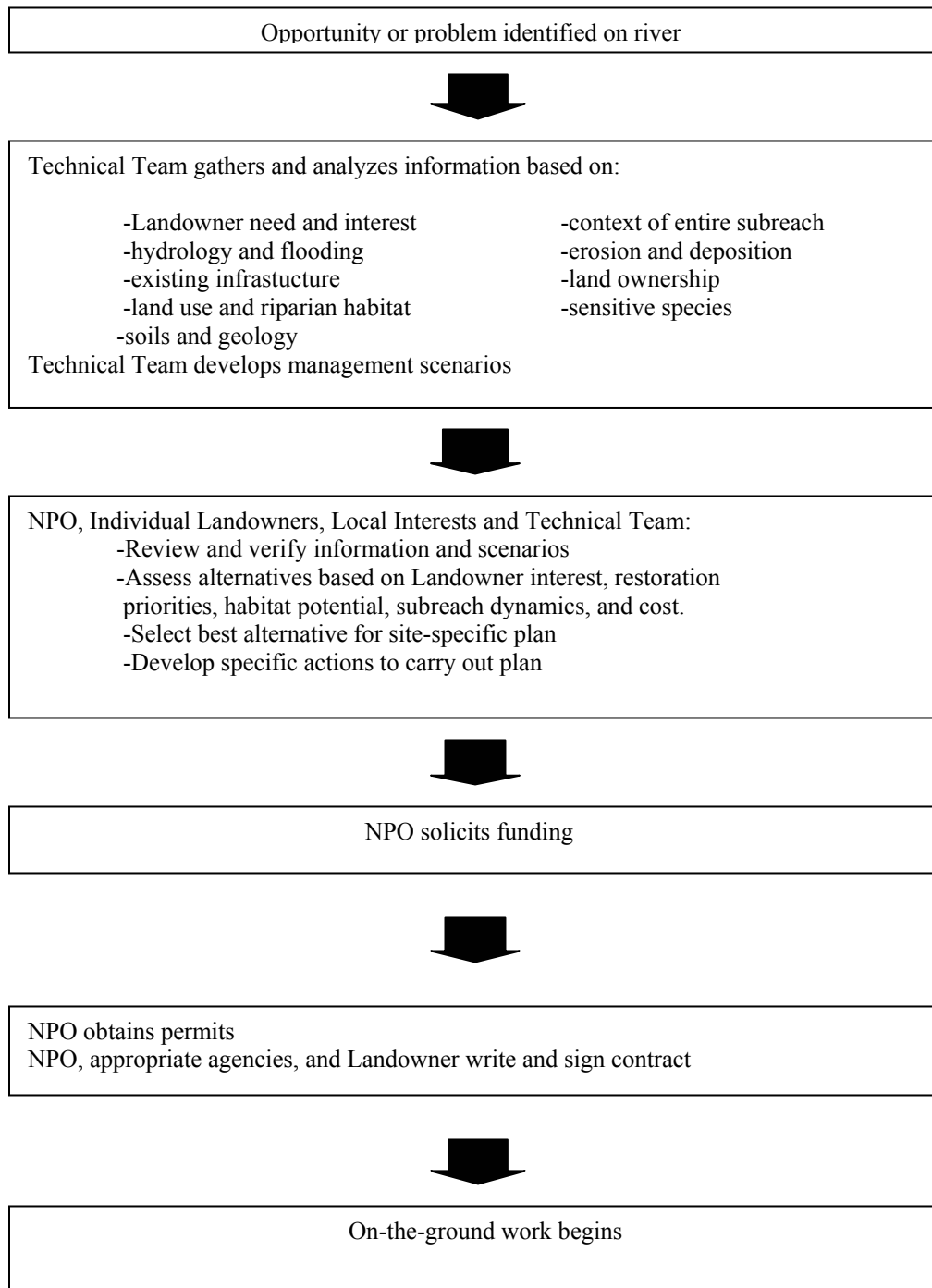
Site-specific management plans will provide the building blocks of the Sacramento River Conservation Area, particularly in areas falling within the inner river zone guidelines (Figure 9-1).

A site-specific plan should outline the current condition of a particular sub-reach and the potential that exists to protect and restore habitats and river processes. Consideration is given to ecological processes (flooding and channel migration), habitats (riparian forests, sloughs, gravel bars, and shaded riverain aquatic), and identified locations of sensitive sites (bank swallow colonies, yellow-billed cuckoo nests, and winter run chinook salmon redds). In addition, current land use, ownership, and development infrastructure is important in determining realistic restoration projects. The plans should address issues that could affect neighboring landowners, such as fire and trespass problems. Any negative effects on local tax bases that might result from restoration of the site should also be addressed.

After the potential for riparian restoration within a reach is reviewed and reasonable objectives are formulated, more detailed data obtained from field studies are necessary for site-specific decisions.

The site-specific plan should describe program eligibility and where proposed management actions would rank in terms of the overall riparian restoration strategy. The highest priority projects are those that preserve intact process and are cost effective.

Figure 9-1. *Site-specific management planning.*



Recommended Actions

Project alternatives should be evaluated in terms of net change in riparian vegetation compared to a no-project alternative.

A draft proposal based on the greatest biological benefit at the least cost should be developed with input from potentially affected landowners. This document (possibly the final site-specific plan with recommendations) should become the foundation for negotiations with landowners and the basis of a formal funding proposal.

Actions that could be included as part of the site-specific management plan include conservation easements, set-aside agreements, bank protection, acquisition, landowner protections, and floodplain management. These actions will be carried out through contractual agreements on individual properties which will contain enforcement provisions if either party violates the contract. The following actions could be taken as part of a site-specific management plan.

Conservation easements

Conservation easements are restrictions landowners voluntarily place on their property that legally bind the present and future owners. Generally, an easement is sold or donated to a trustee agency or organization. A conservation easement may prohibit some activities in order to protect the habitat, vegetation, or wildlife found on the land. Conservation easements do not, as a rule, allow public access. Several state and federal agencies currently use conservation easements as a tool to protect valuable habitat and river processes along the Sacramento River. Some county general plans suggest conservation easements with private landowners as a means of improving public access to the river. The proposed nonprofit management entity would work with existing state, federal, or local easement programs, or may develop its own easement program.

Conservation easements would be incorporated into site-specific management plans. The NPO may institute conservation easements using contract agreements on individual properties which contain enforcement provisions if the contract is violated by either party.

Set-aside agreements

The purpose of a set-aside program is to provide additional incentives for private landowners (who own 66% of the land in the Conservation Area) to voluntarily participate in riparian habitat conservation. Much of the eligible land which could be preserved in riparian habitat is potentially high quality agricultural land and could be profitable for the owners to farm, while some of the eligible land is already in crops. Other eligible land is not as suitable for crops, but landowners want to retain control for many reasons. A set-aside program would provide an incentive to phase out agricultural activities and let the land return to riparian habitat for farmers who either wish to maintain ownership control over the land or prefer limited-term arrangements.

A set-aside program, carried out by the proposed nonprofit management entity, would offer an option for dedicating land for habitat purposes that is short of selling a fee or easement interest. Set-aside agreements would be short-term, e.g. for five years—akin to a lease arrangement. They would have an automatic renewal provision and requirement notification, e.g. for five consecutive years, in order to withdraw-----akin to a Williamson Act contract. At the time of this writing, it is recog-

nized that a set-aside program would be new and unique and there are a number of legal and policy details which will need to be worked out prior to implementation. The description provided here, which builds upon the language in the 1989 Plan, should be regarded as laying out the basic intents and concepts for this innovative idea.

Set-aside agreements between the proposed nonprofit management entity and riparian landowners would normally include an annual per acre payment. The payment amount would be based on the original acreage at the time of the agreement, and this status would not be affected by natural river dynamics of erosion, deposition, or flooding. In general, landowners would agree to not develop their riparian lands within the area subject to the set-aside agreement. Land management provisions would be similar to those contained in conservation easements. In some instances, landowners would reserve the right to conduct agriculturally related or non-commercial activities such as gravel removal for on-farm needs, drainage, access, riparian water use, or private recreational use. Landowners would allow deposition, erosion, and/or riparian plant growth to take place with a minimum of interference, and might even choose to manage their lands actively within the Conservation Area to enhance wildlife habitat in a manner consistent with the plan and handbook. Landowners would provide access to appropriate individuals as necessary to monitor habitat conditions.

A participating landowner would submit a set-aside plan to the proposed nonprofit management entity for approval. The management entity would be available to assist the landowners in preparing the plan, which must be within the guidelines of the 1989 Plan and Handbook. Participation in the agreement by landowners would be voluntary. The minimum participation period would be one to five years with automatic renewal. To withdraw from participation in the Conservation Area, a landowner must give notice for five consecutive years. Annual per acre payment would be based on a percentage of the appraised fair market value of comparable agricultural or open space land. In the event of change of ownership, participation would transfer with the land. Funds for set-aside payments must be based on a stable, secure source of funds such as interest on an endowment, and not rely on year-to-year State or Federal budgets.

Specifics of a set-aside plan or agreement would vary from landowner to landowner, depending upon individual circumstances and needs. Set-aside agreements may address details regarding erosion control or payment terms in a variety of ways. For example, an agreement might have an individual landowner allow the river bank to erode naturally on his or her land, in exchange for an annual payment based on that portion allowed to erode. Another example agreement might include allowing bank erosion in exchange for an annual payment along with a commitment for bank protection to be placed after the bank retreats a predetermined distance. After bank protection is placed, the annual payment could be ceased. When bank protection is a part of an individual agreement, it is anticipated the nonprofit management entity would be responsible for installation and maintenance, although this would be up to the individual landowner. For landowners on the accreting, rather than eroding, side of the river, a set-aside agreement might provide an annual payment in exchange for the landowner allowing riparian habitat succession and growth to proceed without clearing.

Other details for the nonprofit management entity to consider would be giving premiums to longer agreements, and lower payments for shorter terms. Payments would also be lower when landowners wish to retain more usage rights such as gravel extraction, recreational access, grazing, or other related activities.

At the present time under today's agricultural conditions it is estimated that \$300 per acre per year will be the amount necessary to attract landowners to enroll in a set-aside program. On the other hand, current policies of government agencies and major conservation organizations, who are the most likely source of funding for the riparian habitat protection and restoration, make them reluctant or unable to make annual payments which in total approach full purchase price or perpetual easement price in exchange for only short-term conservation benefits. Highest priority for expenditure and management will generally be for permanent habitat protection. However, the shorter-term set-aside program may provide protection options for some key riparian lands not otherwise able to be acquired.

Bank protection

Part of the incentive for landowners to enroll land in the Conservation Area may be the provision of effective bank protection at locations indicated in the site-specific management plans, using the restoration priorities and management principles discussed in this *Handbook*. The proposed nonprofit management entity may be responsible for effective bank stabilization at these sites as described in the site-specific plans and any associated contracts. Agreements regarding installation and maintenance of bank protection will be determined as part of negotiations between the management entity and landowner. Selection of sites where protection is needed should consider the location of the inner river zone and the preservation of river processes (e.g. erosion, deposition and flooding). Site selection should be made according to sound technical criteria, including land use and structures, hydrologic, hydraulic and geotechnical. Plan formulation should include evaluation of a wide range of alternative protection methods. Further research and evaluation of new methods and techniques, including setback levees and windrowed and trenched rock, should be supported.

Acquisition

Fee title purchase is the purchase of land from willing sellers. It has been the most common method of riparian habitat protection by wildlife agencies and conservation organizations along the Sacramento River. For example, approximately 8,798 acres (24 percent) of the Conservation Area between Red Bluff and Chico Landing is publicly owned. Fee title purchase is a valuable but expensive tool for riparian habitat conservation. Issues that should be addressed by the proposed nonprofit management entity as part of fee title acquisition include the impact to local tax revenue, and a potential increase in trespassing problems. Careful planning will be needed to avert problems stemming from improved access to river lands, such as increased fire danger, problems for adjacent agricultural operations, and adverse effects on habitat and wildlife. Enforcement of trespass laws should become a high priority of agencies and counties.

Any fee title purchases made by the nonprofit management entity would include the full payment in-lieu of taxes to local governments. The entity would support the

full payment in-lieu of taxes by government agencies and non-profit organizations that acquire land on the Sacramento River, and work to ensure that this occurs.

Landowner protections to be included as part of the work on a specific site include the following:

- addressing impacts to both the project landowner and adjacent landowners which are related to threatened an endangered species through cooperative agency efforts such as “safe harbors”;
- using mechanisms such as endowments to pay for future bank protection if needed;
- including elements such as levees or bank protection as part of the site- specific plan, funding proposals, and contract; addressing patrol and trespass issues in funding proposals and contract;
- addressing impacts to adjacent landowners in funding proposals and contract;

Floodplain management

The site-specific plan could include benefiting riparian habitat and adjacent landowners through the re-location of levees or strengthening them in where sufficient floodplain exists for both public safety and healthy riparian habitat. Such changes should be based on sound technical criteria, including land use and structures, hydrologic, hydraulic, and geotechnical.

Other Actions

Other actions that could be carried out as part of site-specific planning include land trades and transfers of development rights (TDRs). Land trades involve private landowners trading land with the public to obtain acreage less prone to erosion, sedimentation; or flooding. The proposed nonprofit management entity could determine if there is sufficient farmable land outside of the inner river zone guidelines under state or federal ownership to warrant such exchanges. If there is sufficient interest, the entity could co-ordinate such exchanges.

Transfers of development rights are “a method of transferring potential development from a location where local government wishes to limit development to a location where local government is willing to see increased development.” (Resources Agency, 1989) To date, it does not appear that any of the seven counties in the Sacramento River Conservation Area have plans to institute a TDR program. The proposed nonprofit management entity could work with local government in implementing such a program.

Develop regulatory consistency/streamlining program

New policies and concepts are being developed at both the state and federal level in regards to endangered species protection. These new policies focus on two broad principles: first, the resources themselves will be better protected by using ecosystem and multi-species level approaches, rather than a single species focus; and second, the regulated private and public community should be regarded as partners in conservation, to be encouraged through regulatory relief and other incentives. The new policies and ideas are implemented as elements of various endangered species plans and

permit processes such as conservation agreements, habitat conservation plans (HCPs), Natural Communities Conservation Plans (NCCPs) or recovery plans. The proposed nonprofit management entity will take the lead in developing such plans, to ensure that they are consistent with the goals of the *1989 Plan* and the *Handbook*.

Ideally, program participants should obtain “credit” for contributing to a functioning ecosystem and habitat values, and certain environmental impacts associated with other activities on or near the site would be allowed by the permitting agencies. In such cases the benefits to the riparian ecosystem resulting from a landowner’s participation should outweigh negative impacts resulting from other activities of their operation. Such changes to current enforcement or environmental regulations, however, would require not only policy changes at the state and federal levels, but a comprehensive habitat inventory and accounting system, such as a habitat conservation plan.

Other elements of the regulatory consistency/streamlining program should include the following:

- Mitigation Requirements within the Conservation Area

The proposed nonprofit management entity will work with regulatory agencies to avoid, minimize, or compensate for habitat impacts associated with proposed projects. If mitigation is required, the entity would be responsible for working with the regulatory agencies to satisfy the requirements and include the costs as part of the total project cost. The nonprofit management entity will be responsible for obtaining all environmental permits. If certain project elements, such as bank stabilization, are planned for implementation in the future the nonprofit entity should obtain permits up front to ensure that bank stabilization or other activities can occur as intended, and the landowner and the entity can be certain that the project can be implemented as was agreed.

- Interagency Consistency

Permitting and trustee agencies should agree on consistent guidelines for the mitigation of environmental impacts and confirm by executing MOUs or MOAs. Such guidelines should be applied consistently (e.g. constant ratios for habitat compensation in similar cases); be internally consistent among different ecosystem elements (e.g. species protection windows make sense); and be reasonable in the context of other public needs (e.g. water quality or flood protection). Mitigation guidelines, such as for the Swainson’s Hawk, should be consolidated for the entire Sacramento River Conservation Area, consistent with the existing species recovery plan. Such agreements will benefit riparian habitat as well as providing consistency for private landowners seeking permits. The proposed nonprofit management entity would provide leadership in the development of consistent guidelines.

- Consolidation of Application Forms

Upon formation of the management entity, a high priority will be given to the establishment of a “one stop shop” for obtaining permits. Certain activities along the Sacramento River may have minimal or somewhat predictable environmental impacts. These activities may include clearing irrigation ditches, installing culverts, repairing and maintaining bank protection, or planting vegetation on levee berms. Such activities would be handled by master permits or agreements from an agency or through a

consolidated application process. The proposed nonprofit management entity would facilitate agency cooperation in the development of a new, single standard form which would be submitted in place of the separate ones now required. If master or regional permits were in place, the proposed nonprofit management entity would apply for permits for certain activities which are analyzed within the context of the goals of the *1989 Plan* and the more specific management principles in this *Handbook*. This should provide for more efficient review of subsequent individual activities that are consistent with the goals and principles of the *1989 Plan* and this *Handbook*.

- Mitigation Banking

Several agencies currently protect or restore riparian habitat on the Sacramento River under mitigation agreements. Activities likely to require mitigation include bank protection and flood control work. Arrangements are made on a case-by-case basis with the U.S. Fish and Wildlife Service and the California Department of Fish and Game. The proposed nonprofit management entity may administer a trust account that could be used for riparian land acquisition or management, consistent with the goals of the *1989 Plan* and this *Handbook*.

Develop mutual assistance program

Problems associated with public access and trespass are major concerns with area landowners, conservation groups, and agencies. A focus of the *1989 Plan* is to develop and manage specific public access and recreation areas and severely limit and control public trespass on private and public lands. Present staffing however does not permit adequate monitoring, maintenance, and law enforcement on some public land. User fees and/or legislated monies should be established to help cover enforcement and management costs. Patrol and trespass issues should also be dealt with at the level of the site-specific plan. The proposed nonprofit management entity would pursue opportunities to fund personnel to patrol river lands.

Develop education and outreach program

The proposed nonprofit management entity would provide technical assistance to private and public landowners along the river regarding river system processes and riparian habitat protection and restoration. The entity would rely on the technical advisory team to help provide the technical information. The entity would also provide information to the public and local communities regarding the benefits of the Conservation Area and of balancing the protection and restoration of riparian habitat with agricultural land uses. Increasing local and regional appreciation of the Sacramento River system will provide important support for the goals of the proposed management entity. Elements of this education and outreach effort include:

- Information Clearinghouse

The proposed nonprofit management entity would coordinate with agencies and organizations to provide information on grant or other funding opportunities for Sacramento River landowners.

- Workshops, Forums and Interpretive Programs

The proposed nonprofit management entity may develop informational workshops and forums on a variety of subjects of interest to landowners and other river users.

Subjects of interest could include geomorphology and sedimentation, flooding, agricultural, or wildlife issues. In addition, the management entity may assist with setting up outdoor interpretive programs on biological and agricultural topics on the Sacramento River. This work may be done in cooperation with other organizations, such as the Sacramento River Discovery Center. To assist private landowners in conducting restoration projects or become contractors in riparian restoration, the management entity could sponsor riparian restoration seminars and hands-on workshops.

- Public Education on River Access

Trespass problems in the Sacramento River Conservation Area should be lessened through public education, enforcement of existing trespass laws, and by providing adequate access opportunities. A good education program could include the use of standardized brochures, maps and signs throughout the conservation area. The entity should develop these items in cooperation with chambers of commerce and recreational businesses along the river.

- Newsletter

There is currently no regular information source that provides people with updates on all types of issues along the Sacramento River. The entity may publish a newsletter that would address Sacramento River issues from a broad perspective and provide it to a wide variety of interests. Updates would be provided on issues such as erosion, flooding, scientific studies, current legislation, the Sacramento River Wildlife Refuge, Department of Fish and Game lands, and volunteer opportunities. The proposed nonprofit management entity may also develop informational brochures on public access along the river (for distribution in cooperation with other agencies), and educational brochures on Sacramento River wildlife habitats, forest succession, and geomorphology.

- Exotics Control

The entity may take a leading role in the control of exotic plant species that threaten the Sacramento River riparian ecosystem. Activities should include public education on the impact of exotic invasives on riparian systems. The entity may coordinate or cooperate in efforts to assess the overall impact of exotic vegetation on the river and tributary systems and develop and implement an eradication and control program.

Support monitoring and research programs

The entity will monitor and report on progress toward meeting the goals of the *1989 Plan*, the more specific management objectives outlined in this *Handbook*, as well as the success of site-specific management plans. In addition, the proposed nonprofit management entity may cooperate with research efforts being conducted by agencies or institutions that coincide with the goals of the proposed entity. These include the following:

- Information Management (GIS)

Under the SB1086 program, the California Department of Water Resources has developed a Sacramento River geographic information system (GIS) as a planning tool to help resolve management questions as they arise at specific river locations. The Sacramento River GIS uses both the Geo/SQL and ArcView GIS pro-grams. Information indexed in this system and currently available for query includes historical river mean-

ders since 1896, geology, projected erosion rates and locations for the next 50 years, property ownership, areas within the 100-year floodline, and current and historical riparian habitat, soils, and bank face characteristics. The proposed nonprofit management entity will use the information in this system through the technical advisory team.

- Model for Prioritizing Habitat

A management model should be developed for each region of the valley floor and major reach of the River to allow for prioritization of habitats, optimization of biological diversity, and maintenance of ecological integrity. This would result in the data necessary for the development, for example, of a habitat conservation planning area. The proposed entity and its technical advisory team could provide information to agencies or academic institutions in support of this effort.

- Studies on Succession, Geomorphic, and Hydrologic Processes

Lack of data on the dynamics of riparian forest succession along the Sacramento River hinders discussion. A coordinated effort of data collection and research is needed to study the relationship of riparian forest succession along the Sacramento River to the flooding/flow regime, time of seed dispersal, channel migration, and substrate conditions. Interested parties would include the Nature Conservancy, the U.S. Fish and Wildlife Service, the Departments of Fish and Game and Water Resources and the CSU, Chico and UC Davis.

Geomorphic processes are an important component of the dynamics of succession. Key to its understanding are the collection and analysis of data on Sacramento River erosion, deposition and meandering. This information will be essential to understanding and predicting long-range changes caused by dam construction, bank protection and gravel mining on the tributaries. The proposed nonprofit management entity would support such research efforts.

- Topographic Mapping of Sacramento River System

Up-to-date topographic information for the Sacramento River north of the Sacramento River Flood Control Project (River Mile 194) does not exist, making detailed hydrologic/hydraulic modeling impossible. This information would provide the backbone for flow, fish habitat, and forest regeneration studies along the Sacramento River. The proposed entity would support efforts to conduct such mapping.

- Vegetation Monitoring

Current vegetation monitoring using color infrared aerial photography and photo interpretation, should continue. The SB1086 program has completed the monitoring of riparian forest habitat through 1995 in Shasta, Tehama, Butte, and Glenn Counties. Monitoring has not been conducted in Colusa and Yolo counties since 1987 and needs to be updated. The nonprofit entity would support such mapping efforts.

Success of site-specific management plans should be assessed biannually or more frequently, if necessary. The nonprofit entity would be responsible for monitoring the success of riparian vegetation succession associated with the site-specific management plans.

Sensitive Plants in the Sacramento River Conservation Area

SPECIES (COMMON NAME)	HABITAT	STATUS* FEDERAL/STATE/CNPS
<i>Carex vulpinoidea</i> (fox sedge)	wet places	—/—/2
<i>Cryptantha crinita</i> (Silky cryptantha)	sandy stream banks gravel bars	—/—/1B
<i>Eleocharis quadrangulata</i> (four-angled spikerush)	marshy areas	—/—/2
<i>Hibiscus lasiocarpus</i> (rose mallow)	marshy areas, old river channels	—/—/2
<i>Sagittaria sandfordii</i> (Sandford's arrowhead)	ponds, ditches	—/—/1B

*STATUS:

Federal Listing

(February 28, 1996 Candidate Notice of Review)
FE/FT/FPT+FPE Federal listed endangered, threatened; proposed for listing

State Listing

SR/—/SE State listed rare, or endangered

CNPS – California Native Plant Society Listing

1B Rare, threatened or endangered throughout its range
2 Rare, threatened or endangered in California, but more common elsewhere

Wildlife Species in the Sacramento River Conservation Area

Part 1: Mammals

COMMON NAME	SCIENTIFIC NAME	STATUS
Marsupialia (oppossums)		
Virginia opossum	<i>Didelphis virginiana</i>	
Insectivora (shrews and moles)		
Broad-footed mole	<i>Scapanus latimanus</i>	
Ornate shrew	<i>Sorex ornatus</i>	
Chiroptera (bats)		
Big brown bat	<i>Eptesicus fuscus</i>	
Brazilian free-tailed bat	<i>Tadarida brasiliensis</i>	
California myotis	<i>Myotis californicus</i>	
Hoary bat	<i>Lasiurus cinereus</i>	
Pallid bat	<i>Antrozous pallidus</i>	CSSC
Red bat	<i>Lasiurus borealis</i>	
Townsend's big-eared bat	<i>Plecotus townsendii</i>	FSC, CSSC
Western pipistrelle	<i>Pipistrellus Hesperus</i>	FSC
Yuma myotis	<i>Myotis yumanensis</i>	
Lagomorpha (rabbits and hares)		
Black-tailed hare	<i>Lepus californicus</i>	
Brush rabbit	<i>Sylvilagus bachmani</i>	
Desert cottontail	<i>Sylvilagus audubonii</i>	
Rodentia (rodents)		
Beaver	<i>Castor canadensis</i>	
Black rat	<i>Rattus rattus</i>	I
Botta's pocket gopher	<i>Thomomys bottae</i>	
Brush mouse	<i>Peromyscus boylii</i>	
California ground squirrel	<i>Spermophilus beecheyi</i>	
California kangaroo rat	<i>Dipodomys californicus</i>	FSC, CSSC
California vole	<i>Microtus californicus</i>	
Deer mouse	<i>Peromyscus maniculatus</i>	
Dusky-footed woodrat	<i>Neotoma fuscipes</i>	
Fox squirrel	<i>Sciurus niger</i>	
Gray squirrel	<i>Sciurus carolinensis</i>	
House mouse	<i>Mus musculus</i>	I

Wildlife Species

Muskrat	<i>Ondatra zibethicus</i>	
Norway rat	<i>Rattus norvegicus</i>	I
Porcupine	<i>Erethizon dorsatum</i>	
Pinyon mouse	<i>Peromyscus truei</i>	
Western gray squirrel	<i>Sciurus griseus</i>	
Western harvest mouse	<i>Reithrodontomys megalotis</i>	
Carnivora (carnivores)		
Badger	<i>Taxidea taxus</i>	W
Bobcat	<i>Linx rufis</i>	
Coyote	<i>Canis latrans</i>	
Feral house cat	<i>Felis cattus</i>	I
Golden grizzly bear	<i>Ursus horribilis californicus</i>	Extinct
Gray fox	<i>Urocyon cinereoargenteus</i>	
Long-tailed weasel	<i>Mustela frenata</i>	
Mink	<i>Mustela vison</i>	
Mountain lion	<i>Felis concolor</i>	
Raccoon	<i>Procyon lotor</i>	
Red fox	<i>Vulpes vulpes</i>	I
Ringtail	<i>Bassariscus astutus</i>	
River otter	<i>Lutra canadensis</i>	
Striped skunk	<i>Mephitis mephitis</i>	
Western spotted skunk	<i>Spilogale gracilis</i>	
Artiodactyla (hoofed mammals)		
Mule deer	<i>Odocoileus hemionus</i>	
Pronghorn	<i>Antilocapra americana</i>	Extirpated, reintroduced
Tule elk	<i>Cervus elaphanus nannode</i>	Extirpated, reintroduced
Wild pig	<i>Sus scrofa</i>	I

Part 2: Amphibians

COMMON NAME	SCIENTIFIC NAME	STATUS
Caudata (salamanders)		
California slender salamander	<i>Batrachoseps attenuatus</i>	
Long-toed salamander	<i>Ambystoma macrodactylum</i>	
Tiger salamander	<i>Ambystoma tigrinum</i>	CSSC, FC
Salientia (frogs and toads)		
Bullfrog	<i>Rana catesbeiana</i>	I
Foothill yellow-legged frog	<i>Rana boylei</i>	FSC, CSSC
Pacific treefrog	<i>Hyla regilla</i>	
Red-legged frog	<i>Rana aurora</i>	Extirpated, FT, CSSC
Western spadefoot	<i>Scaphiopus hammondi</i>	FSC, CSSC
Western toad	<i>Bufo boreas</i>	

Part 3: Reptiles

COMMON NAME	SCIENTIFIC NAME	STATUS
Emydidae (turtles)		
Western pond turtle	<i>Clemmys marmorata</i>	FSC, CSSC
Iguanidae (iguana lizards)		
Coast horned lizard	<i>Phrynosoma coronatum</i>	FSC, CSSC
Western fence lizard	<i>Sceloporus occidentalis</i>	
Sagebrush lizard	<i>Sceloporus graciosus</i>	
Scincidae (skinks)		
Gilbert's skink	<i>Eumeces gilberti</i>	
Western skink	<i>Eumeces skiltonianus</i>	
Teiidae (whiptail lizards)		
Western whiptail	<i>Cnemidophorus tigris</i>	
Anguidae (alligator lizards)		
Southern alligator lizard	<i>Gerrhonotus multicarinatus</i>	
Colubridae (Colubrid snakes)		
California mountain king	<i>Lampropeltis zonata</i>	
Striped racer	<i>Masticophis lateralis</i>	
Coachwhip	<i>Masticophis flagellum</i>	
Common garter snake	<i>Thamnophis sirtalis</i>	
Common kingsnake	<i>Lampropeltis getulus</i>	
Giant garter snake	<i>Thamnophis couchi gigas</i>	ST, FT
Gopher snake	<i>Pituophis melanoleucus</i>	
Night snake	<i>Hypsiglena torquata</i>	
Racer	<i>Coluber constrictor</i>	
Ringneck snake	<i>Diadophis punctatus</i>	
Sharp-tailed snake	<i>Contia tenuis</i>	
Western aquatic garter snake	<i>Thamnophis couchi</i>	
Western terrestrial garter snake	<i>Thamnophis elegans</i>	
Viperidae (vipers)		
Western rattlesnake	<i>Crotalis viridis</i>	

Part 4: Birds

COMMON NAME	SCIENTIFIC NAME	STATUS
Gaviiformes (loons)		
Common loon	<i>Gavia immer</i>	CSSC, MNMBC
Podicipediformes (grebes)		
Clark's grebe	<i>Aechmophorus clarkii</i>	W
Eared grebe	<i>Podiceps nigricollis</i>	
Pied-billed grebe	<i>Podilymbus podiceps</i>	
Western grebe	<i>Aechmophorus occidentalis</i>	W
Pelicaniformes (pelicans and cormorants)		
American white pelican	<i>Pelecanus erythrorhynchos</i>	CSSC
Double-crested cormorant	<i>Phalacrocorax auritus</i>	CSSC

Wildlife Species

Anseriformes (ducks, geese, and swans)

American wigeon	<i>Anas americana</i>	
Barrow's goldeneye	<i>Bucephala islandica</i>	CSSC
Blue-winged teal	<i>Anas discors</i>	
Bufflehead	<i>Bucephala albeola</i>	
Canada goose	<i>Branta Canadensis</i>	FT
Canvasback	<i>Aythya valisineria</i>	
Cinnamon teal	<i>Anas cyanoptera</i>	
Common goldeneye	<i>Bucephala clangula</i>	
Common merganser	<i>Mergus merganser</i>	
Eurasian wigeon	<i>Anas penelope</i>	
Gadwall	<i>Anas strepera</i>	
Greater white-fronted goose	<i>Anser albifrons</i>	
Green-winged teal	<i>Anas crecca</i>	
Hooded merganser	<i>Lophodytes cucullatus</i>	
Lesser scaup	<i>Aythya affinis</i>	
Mallard	<i>Anas platyrhynchos</i>	
Northern shoveler	<i>Anas clypeata</i>	
Northern pintail	<i>Anas acuta</i>	
Redhead	<i>Aythya americana</i>	
Ring-necked duck	<i>Aythya collaris</i>	
Ross's goose	<i>Chen rossii</i>	
Ruddy duck	<i>Oxyura jamaicensis</i>	
Snow goose	<i>caerulescens</i>	
Tundra swan	<i>Cygnus columbianus</i>	
Wood duck	<i>Aix sponsa</i>	

Falconiformes (vultures, hawks, eagles, and falcons)

American kestrel	<i>Falco sparverius</i>	
Bald eagle	<i>Haliaeetus leucocephalus</i>	FT, SE
California condor	<i>Gymnogyps californianus</i>	Extirpated - reintroduced
Cooper's hawk	<i>Accipiter cooperii</i>	CSSC
Ferruginous hawk	<i>Buteo regalis</i>	FSC, CSSC
Golden eagle	<i>Aquila chrysaetos</i>	CSSC
Merlin	<i>Falco columbarius</i>	CSSC
Northern harrier	<i>Circus cyaneus</i>	CSSC
Osprey	<i>Pandion haliaetus</i>	CSSC
Peregrine falcon	<i>Falco peregrinus</i>	SE, MNBMC
Prairie falcon	<i>Falco mexicanus</i>	CSSC
Red-shouldered hawk	<i>Buteo lineatus</i>	
Red-tailed hawk	<i>Buteo jamaicensis</i>	
Rough-legged hawk	<i>Buteo lagopus</i>	
Sharp-shinned hawk	<i>Accipiter striatus</i>	CSSC
Swainson's hawk	<i>Buteo swainsoni</i>	ST
Turkey vulture	<i>Cathartes aura</i>	
Black-shouldered kite	<i>Elanus leucurus</i>	W, MNBMC

Galliformes (turkeys, grouse, quail, and pheasants)

California quail	<i>Callipepla californica</i>	
Ring-necked pheasant	<i>Phasianus colchicus</i>	I
Wild turkey	<i>Meleagris gallopavo</i>	I

Ciconiiformes (herons and egrets)

American bittern	<i>Botaurus lentiginosus</i>	MNBNC
Black-crowned night heron	<i>Nycticorax nycticorax</i>	W
Cattle egret	<i>Bubulcus ibis</i> I	
Great egret	<i>Casmerodius albus</i>	W
Great-blue heron	<i>Ardea herodias</i>	W
Green-backed heron	<i>Butorides striatus</i>	
Snowy egret	<i>Egretta thula</i>	W
Western least bittern	<i>Ixobrychus exilis</i>	FSC, CSSC
White-faced ibis	<i>Plegadis chihi</i>	FSC, CSSC

Gruiformes (cranes and rails)

American coot	<i>Fulica americana</i>	
Common moorhen	<i>Gallinula chloropus</i>	
Sandhill crane	<i>Grus canadensis</i>	ST
Sora	<i>Porzana carolina</i>	
Virginia rail	<i>Rallus limicola</i>	

Charadriiformes (shorebirds and gulls)

American avocet	<i>Recurvirostra americana</i>	
Black tern	<i>Chlidonias niger</i>	FSC, CSSC
Black-bellied plover	<i>Pluvialis squatarola</i>	
Black-necked stilt	<i>Himantopus mexicanus</i>	
Bonaparte's gull	<i>Larus philadelphia</i>	
California gull	<i>Larus californicus</i>	CSSC
Common snipe	<i>Gallinago gallinago</i>	
Dunlin	<i>Calidris alpina</i>	
Forster's tern	<i>Sterna forsteri</i>	W
Greater yellowlegs	<i>Tringa melanoleuca</i>	
Herring gull	<i>Larus argentatus</i>	
Killdeer	<i>Charadrius vociferus</i>	
Least sandpiper	<i>Calidris minutilla</i>	
Lesser yellowlegs	<i>Tringa flavipes</i>	
Long-billed curlew	<i>Numenius americanus</i>	CSSC, MNBNC
Long-billed dowitcher	<i>Limnodromus scolopaceus</i>	
Mew gull	<i>Larus canus</i>	
Mountain plover	<i>Charadrius montanus</i>	FC, CSSC
Red-necked phalarope	<i>Phalaropus lobatus</i>	
Ring-billed gull	<i>Larus delawarensis</i>	
Short-billed dowitcher	<i>Limnodromus griseus</i>	
Solitary sandpiper	<i>Tringa solitaria</i>	
Spotted sandpiper	<i>Actitis macularia</i>	
Western sandpiper	<i>Calidris mauri</i>	
Western snowy plover	<i>Charadrius alexandrinus nivosus</i>	CSSC, MNBNC
Wilson's phalarope	<i>Phalaropus tricolor</i>	

Columbiformes (pigeons and doves)

Band-tailed pigeon	<i>Columba fasciata</i>	
Mourning dove	<i>Zenaida macroura</i>	

Cuculiformes (cuckoos and roadrunners)

Roadrunner	<i>Geococcyx californianus</i>	
Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>	SE

Strigiformes (owls)

Barn owl	<i>Tyto alba</i>	
Burrowing owl	<i>Athene cunicularia</i>	FSC, CSSC
Great horned owl	<i>Bubo virginianus</i>	
Long-eared owl	<i>Asio otus</i>	CSSC
Northern pygmy owl	<i>Glaucidium gnoma</i>	
Short-eared owl	<i>Asio flammeus</i>	CSSC, MNBMC
Western screech owl	<i>Otus kennicottii</i>	

Caprimulgiformes (goatsuckers and nighthawks)

Common nighthawk	<i>Chordeiles minor</i>	
Common poorwill	<i>Phalaenoptilus nuttallii</i>	
Lesser nighthawk	<i>Chordeiles acutipennis</i>	

Apodiformes (swifts and hummingbirds)

Anna's hummingbird	<i>Calypte anna</i>	
Black-chinned hummingbird	<i>Archilochus alexandri</i>	
Calliope hummingbird	<i>Stellula calliope</i>	
Rufous hummingbird	<i>Selasphorus rufus</i>	MNBMC
Vaux's swift	<i>Chaetura vauxi</i>	CSSC, MNBMC

Coraciiformes (kingfishers)

Belted king fisher	<i>Ceryle alcyon</i>	
--------------------	----------------------	--

Piciformes (woodpeckers)

Acorn woodpecker	<i>Melanerpes formicivorus</i>	
Downy woodpecker	<i>Picoides pubescens</i>	
Hairy woodpecker	<i>Picoides villosus</i>	
Lewis' woodpecker	<i>Melanerpes lewis</i>	
Northern flicker	<i>Colaptes auratus</i>	
Nuttall's woodpecker	<i>Picoides nuttallii</i>	
Red-breasted sapsucker	<i>Sphyrapicus ruber</i>	

Passeriformes

American crow	<i>Corvus brachyrhynchos</i>	
American dipper	<i>Cinclus mexicanus</i>	
American goldfinch	<i>Carduelis tristis</i>	
American pipit	<i>Anthus rubescens</i>	
American robin	<i>Turdus migratorius</i>	
Ash-throated flycatcher	<i>Myiarchus cinerascens</i>	
Bank swallow	<i>Riparia riparia</i>	ST
Barn swallow	<i>Hirundo rustica</i>	
Bewick's wren	<i>Thryomanes bewickii</i>	
Black phoebe	<i>Sayornis nigricans</i>	
Black-headed grosbeak	<i>Pheucticus melanocephalus</i>	
Black-throated grey warble	<i>Dendroica nigrescens</i>	
Blue grosbeak	<i>Guiraca caerulea</i>	
Blue-grey gnatcatcher	<i>Polioptila caerulea</i>	
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	
Brown creeper	<i>Certhia americana</i>	
Brown-headed cowbird	<i>Molothrus ater</i>	
Brown towhee	<i>Pipilo fuscus</i>	
Bushtit	<i>Psaltiriparus minimus</i>	
California horned lark	<i>Eremophila alpestris</i>	CSSC

California thrasher	<i>Toxostoma redivivum</i>	
Cedar waxwing	<i>Bombycilla cedrorum</i>	
Chipping sparrow	<i>Spizella passerina</i>	
Cliff swallow	<i>Hirundo pyrrhonota</i>	
Common raven	<i>Corvus corax</i>	
Common yellowthroat	<i>Geothlypis trichas</i>	
Dark-eyed junco	<i>Junco hyemalis</i>	
Dusky flycatcher	<i>Empidonax oberholseri</i>	
European starling	<i>Sturnus vulgaris</i>	I
Evening grosbeak	<i>Coccothraustes vespertinus</i>	
Fox sparrow	<i>Passerella iliaca</i>	
Golden-crowned kinglet	<i>Regulus satrapa</i>	
Golden-crowned sparrow	<i>Zonotrichia atricapilla</i>	
Hammond's flycatcher	<i>Empidonax hammondi</i>	
Hermit thrush	<i>Catharus guttatus</i>	MNBMC
Hermit warbler	<i>Dendroica occidentalis</i>	
Hooded oriole	<i>Icterus cucullatus</i>	
House finch	<i>Carpodacus mexicanus</i>	
House sparrow	<i>Passer domesticus</i>	I
House wren	<i>Troglodytes aedon</i>	
Hutton's vireo	<i>Vireo huttoni</i>	
Lark sparrow	<i>Chondestes grammacus</i>	MNBMC
Lawrence's goldfinch	<i>Carduelis lawrencei</i>	MNBMC
Luzuli bunting	<i>Passerina amoena</i>	
Least Bell's vireo	<i>Vireo bellii pusillus</i>	FE, SE
Lesser goldfinch	<i>Carduelis psaltria</i>	
Lincoln's sparrow	<i>Melospiza lincolnii</i>	
Loggerhead shrike	<i>Lanius ludovicianus</i>	FSC,CSSC
MacGillivray's warbler	<i>Oporornis tolmiei</i>	
Marsh wren	<i>Cistothorus palustris</i>	
Mountain bluebird	<i>Sialia currucoides</i>	
Mountain chickadee	<i>Parus gambeli</i>	
Nashville warbler	<i>Vermivora ruficapilla</i>	
Northern mockingbird	<i>Mimus polyglottos</i>	
Northern oriole	<i>Icterus galbula</i>	
Northern rough-winged swallow	<i>Stelgidopteryx serripennis</i>	
Northern shrike	<i>Lanius excubitor</i>	
Northern waterthrush	<i>Seiurus noveboracensis</i>	
Oak titmouse	<i>Parus inornatus</i>	
Orange-crowned warbler	<i>Vermivora celata</i>	
Pacific-slope flycatcher	<i>Empidonax difficilis</i>	
Pine siskin	<i>Carduelis pinus</i>	
Purple finch	<i>Carpodacus purpureus</i>	
Purple martin	<i>Progne subis</i>	CSSC
Red-breasted nuthatch	<i>Sitta canadensis</i>	
Red-winged blackbird	<i>Agelaius phoeniceus</i>	
Ruby-crowned kinglet	<i>Regulus calendula</i>	
Rufous-sided towhee	<i>Pipilo erythrophthalmus</i>	
Savannah sparrow	<i>Passerculus sandwichensis</i>	
Say's phoebe	<i>Sayornis saya</i>	

Scrub jay	<i>Aphelocoma coerulescens</i>	
Solitary vireo	<i>Vireo solitarius</i>	
Song sparrow	<i>Melospiza melodia</i>	
Stellar's jay	<i>Cyanocitta stelleri</i>	
Swainson's thrush	<i>Catharus ustulatus</i>	
Townsend's warbler	<i>Dendroica towsendi</i>	
Tree swallow	<i>Tachycineta bicolor</i>	
Tri-colored blackbird	<i>Agelaius tricolor</i>	FSC, CSSC
Varied thrush	<i>Ixoreus naevius</i>	
Violet-green swallow	<i>Tachycineta thalassina</i>	
Warbling vireo	<i>Vireo gilvus</i>	
Western bluebird	<i>Sialia mexicana</i>	
Western kingbird	<i>Tyrannus verticalis</i>	
Western meadowlark	<i>Sturnella neglecta</i>	
Western tanager	<i>Piranga ludoviciana</i>	
Western wood pewee	<i>Contopus sordidulus</i>	
White-breasted nuthatch	<i>Sitta carolinensis</i>	
White-crowned sparrow	<i>Zonotrichia leucophrys</i>	
White-throated sparrow	<i>Zonotrichia albicollis</i>	
Willow flycatcher	<i>Empidonax traillii*</i>	SE
Wilson's warbler	<i>Wilsonia pusilla</i>	
Winter wren	<i>Troglodytes troglodytes</i>	
Yellow rumped warbler	<i>Dendroica coronata</i>	
Yellow warbler	<i>Dendroica petechia</i>	CSSC
Yellow-billed magpie	<i>Pica nuttalli</i>	
Yellow-breasted chat	<i>Icteria virens</i>	CSSC
Yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	

Part 5: Fish

COMMON NAME	SCIENTIFIC NAME	STATUS
Acipenseridae (sturgeon)		
Green sturgeon	<i>Acipenser medirostris</i>	CSSC
White sturgeon	<i>Acipenser transmontanus</i>	
Petromyzontidae (lamprey)		
Pacific brook lamprey	<i>Lampetra pacifica</i>	
Pacific lamprey	<i>Lampetra tridentata</i>	
River lamprey	<i>Lampetra ayresi</i>	
Clupeidae (herring)		
American shad	<i>Alosa sapidissima</i>	I
Threadfin shad	<i>Dorosoma petenense</i>	I
Salmonidae (salmon and trout)		
Brown trout	<i>Salmo trutta</i>	I
Chinook salmon, fall-run	<i>Oncorhynchus tshawytscha</i>	
Chinook salmon, late fall-run	<i>Oncorhynchus tshawytscha</i>	
Chinook salmon, winter-run	<i>Oncorhynchus tshawytscha</i>	SE, FE
Chinook salmon, spring-run	<i>Oncorhynchus tshawytscha</i>	CC
Chum salmon	<i>Oncorhynchus keta</i>	
Coho salmon	<i>Oncorhynchus kisutch</i>	FT

Wildlife Species

Pink salmon	<i>Oncorhynchus gorbuscha</i>	
Sockeye salmon	<i>Oncorhynchus nerka</i>	
Steelhead trout	<i>Oncorhynchus mykiss</i>	CSSC, FT
Cyprinidae (minnow)		
Blackfish	<i>Orthodon microlepidotus</i>	
California roach	<i>Hesperoleucus symmetricus</i>	
Carp	<i>Cyprinus carpio</i>	I
Fathead minnow	<i>Pimephales promelas</i>	I
Golden shiner	<i>Notemigonus crysoleucas</i>	I
Goldfish	<i>Carassius auratus</i>	I
Hardhead	<i>Mylopharodon conocephalus</i>	
Hitch	<i>Lavinia exilicauda</i>	
Lahontan redbreast	<i>Richardsonius egregius</i>	I
Sacramento splittail	<i>Pogonichthys macrolepidotus</i>	FT
Sacramento squawfish	<i>Ptychocheilus grandis</i>	
Speckled dace	<i>Rhinichthys osculus</i>	
Thicktail chub	<i>Gila crassicauda</i>	Extinct
Tui chub	<i>Gila bicolor</i>	
Catostomidae (sucker)		
Sacramento sucker	<i>Catostomus occidentalis</i>	
Ictaluridae (catfish)		
Black bullhead	<i>Ictalurus melas</i>	I
Brown bullhead	<i>Ictalurus nebulosus</i>	I
Channel catfish	<i>Ictalurus punctatus</i>	I
White catfish	<i>Ictalurus catus</i>	I
Yellow bullhead	<i>Ictalurus natalis</i>	I
Poeciliidae (livebearer)		
Mosquitofish	<i>Gambusia affinis</i>	I
Atherinidae (silverside)		
Mississippi silverside	<i>Menidia audens</i>	I
Gasterosteidae (stickleback)		
Threespine stickleback	<i>Gasterosteus aculeatus</i>	
Percichthyidae (temperate basses)		
Striped bass	<i>Morone saxatilis</i>	I
Centrarchidae (sunfish)		
Black crappie	<i>Pomoxis nigromaculatus</i>	I
Bluegill	<i>Lepomis macrochirus</i>	I
Green sunfish	<i>Lepomis cyanellus</i>	I
Largemouth bass	<i>Micropterus salmoides</i>	I
Pumpkinseed	<i>Lepomis gibbosus</i>	
Redear sunfish	<i>Lepomis microlophus</i>	I
Sacramento perch	<i>Archoplites interruptus</i>	
Smallmouth bass	<i>Micropterus dolomieu</i>	I
Spotted bass	<i>Micropterus punctulatus</i>	I
Warmouth	<i>Lepomis gulosus</i>	I
White crappie	<i>Pomoxis annularis</i>	I

Wildlife Species

Percidae (perch)

Bigscale logperch

Percina macrolepida

I

Embiotocidae (surfperch)

Tule perch

Hysterocarpus traski

Cottidae (sculpin)

Prickly sculpin

Cottus asper

Riffle sculpin

Cottus gulosus

Staghorn sculpin

Leptocottus armatus

Legal Status Key

Federal Endangered

FE

State Endangered

SE

Federal Threatened

FT

Federal Species of Concern

FSC

Federal Migratory Non-game Bird of Management Concern

MNBMC

Federal Candidate

FC

State Threatened

ST

California Species of Special Concern

CSSC

California Candidate

CC

Watch

W

Extinct

Extinct

Extirpated

Extirpated

Introduced

I

Part 6: Invertebrates (special status only)

COMMON NAME	SCIENTIFIC NAME	STATUS
Coleoptera		
Valley elderberry longhorn beetle	<i>Desmocerus californicus</i> <i>ssp. diamorphus</i>	FT

Sacramento River Geographic Information System

The Sacramento River Geographic Information System was developed by the California Department of Water Resources in cooperation with the Senate Bill 1086 Advisory Council.

Its primary purpose is to assist with carrying out the objective of the Upper Sacramento River Fisheries and Riparian Habitat Management Plan, which is to reestablish a continuous riparian ecosystem along the Sacramento River between Keswick and Verona. It is intended to help with locally based decision-making, assisting both scientists and laypeople in understanding and analyzing land use and vegetation patterns, flooding, erosion, and channel dynamics on the river.

SUBJECT	DESCRIPTION
Alluvial deposition, active	Active alluvial deposition, as mapped by Halley and Harwood (1985)
Alluvial deposition, recent	Recent alluvial deposition, as mapped by Halley and Harwood (1985)
Bank protection	U.S. Army Corps of Engineers (COE) bank protection and levees, as mapped in 1991 COE Atlas
Bank swallow sites	Location and number of bank swallow burrows (1994)
California Natural Diversity Database	California Natural Diversity Database (CNDDDB)
Channel locations	River channel, selected years between 1896 and 1991
Counties	County boundaries: Siskiyou, Lassen, Del Norte, Lake Mendocino, Humboldt, Shasta, Tehama, Glenn, Colusa, Butte, Sutter, Yolo, Sacramento, San Joaquin, part of Placer, Yuba
Districts: Irrigation, Water and Reclamation	Irrigation, Water and Reclamation Districts within the Sacramento River Conservation Area
Erosion	Erosion projections developed by Koll Buer, 25 and 50 years, with and without riprap (1991)
Flooding, Recurrence Interval Models	Generalized inundation scenarios for various recurrence intervals
Floodline	100-year floodline

Sacramento River Geographical Information System

SUBJECT	DESCRIPTION
Geology	Surface geology, mapped by Harwood & Halley, revised by Koll Buer
Growth Projections	Growth projections for northern Sacramento Valley (Radabaugh)
Land Use	Land use data developed by Department of Water Resources
Levees	Private levees (1978)
Meanderbelt, 50 year	U.S. Army Corps of Engineers' 50-year meander belt (1981)
Meanderbelt, 150 year, (inner river zone guideline)	100-year meanderbelt plus 50-year erosion projections
Meanderbelt, 100 year	Aggregate river channels, 1896-1991
Ownership	Property ownership (1995)
Planning boundary	Proposed Sacramento River Conservation Area
Political districts	State and federal political districts
Precipitation	Precipitation isohyets
Quadrangle sheets	USGS 7.5' quad boundaries and names
Reaches	Four broad reaches between Keswick Dam and Verona
Section lines	Section lines
Seepage areas	High risk seepage areas (Prieststaff)
Soils	Soils as mapped by Soil Conservation Service
Vegetation, bank	Bank mapping (1995)
Vegetation, bank	Bank mapping (1996)
Vegetation, flood protection	Riparian vegetation sites important for flood control (MBK sites)
Vegetation, 1952	Riparian vegetation (1952), mapped by McGill
Vegetation, 1987	Riparian vegetation (1987), mapped by McGill
Vegetation, since 1994	Riparian vegetation, mapped by CSU Chico
Water Diversions	Draft agricultural water diversion data (1994), from California Department of Fish and Game, Inland Fisheries Division
Watersheds	Surface water basins

SUMMARY OF ACREAGE TABULATIONS

Part 1. Land Use.

Keswick - Red Bluff Reach

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	1,334	17%	6,459	35%
Riparian Vegetation	1,490	19%	2,191*	12%*
Upland Vegetation	3,274	41%	6,210*	34%
Urban	852	11%	2,188	12%
Water Surface (excluding main channel)	372	5%	644	3%
Miscellaneous (includes barren wasteland)	643	8%	767	4%
Total Land Surface Area	7,965	101%	18,459	100%
Channel Surface Area	3,005		3,005	
Total	10,970		21,464	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for the most accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding.

Red Bluff - Chico Landing Reach

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	4,854	30%	18,300	53%
Riparian Vegetation	5,662*	35%*	6,864*	20%
Upland Vegetation	2,973*	18%*	5,250*	15%
Water Surface (excluding main channel)	696	4%	695	2%
Miscellaneous (includes barren wasteland)	1,787	11%	1,932	6%
Urban	321	2%	1,301	4%
Total Land Surface Area	16,293	100%	34,342	
Channel Surface Area	2,896		2,896	
Total	19,189		37,238	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for the most accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding.

Part 1. Land Use.

Chico Landing - Colusa Reach

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	1,946	16%	1,946	16%
Riparian Vegetation	5,944	48%	5,944	48%
Upland Vegetation	1,374	11%	1,374	11%
Water Surface (excluding main channel)	275	2%	275	2%
Urban	1,371	11%	1,371	11%
Miscellaneous (includes barren wasteland)	1,583	13%	1,583	13%
Total Land Surface Area	12,493	101%	12,493	101%
Channel Surface Area	2,832		2,832	
Total	15,325		15,325	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for more accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding.

Colusa - Verona Reach

LAND USE CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Agriculture	645	23%	645	23%
Riparian Vegetation	1,113	40%	1,113	40%
Upland Vegetation	589	21%	589	21%
Urban	411	15%	411	15%
Water Surface (excluding main channel)	3	<1%	3	<1%
Miscellaneous (includes barren wasteland)	3	<1%	3	< 1%
Total Land Surface Area	2,764	100%	2,764	100%
Channel Surface Area	1,891		1,891	
Total	4,655		4,655	

*The purpose of DWR land use surveys is to map agricultural crops. **Refer to Appendix D Part 2 for more accurate riparian vegetation data.** Land use data based on DWR agricultural land use surveys of Shasta, Tehama, Butte, Glenn, Colusa, Sutter, and Yolo Counties (see References). Percentages may not be equal to 100 due to rounding.

Part 2. Riparian Vegetation.

Keswick-Red Bluff Reach

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	2,022	25%	2,801	15%
Riparian Scrub	1,101	14%	1,439	8%
Valley Oak Woodland	218	3%	315	2%
Marsh	49	<1%	58	<1%
Blackberry Scrub	37	<1%	61	<1%
Total Riparian Vegetation	3,427	43%	4,674	25%
Total Land Surface Area	7,984		18,474	
Channel Surface Area	3,005		3,005	
Total	10,989		21,479	

GIC(1997;2000). Percentages may not total due to rounding.

Red Bluff - Chico Landing Reach

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	4,417	27%	5,154	15%
Riparian Scrub	3,630	22%	3,929	12%
Valley Oak Woodland	44	<1%	115	<1%
Marsh	97	<1%	141	<1%
Blackberry Scrub	13	<1%	46	<1%
Total Riparian Vegetation	8,201	50%	9,385	27%
Total Land Surface Area	15,904		34,107	
Channel Surface Area	2,896		2,896	
Total	18,800		37,003	

GIC (1997; 2000). Percentages may not total due to rounding.

Part 2. Riparian Vegetation.

Chico Landing-Colusa Reach

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	4,621	42%	4,621	42%
Riparian Scrub	3,276	30%	3,276	30%
Valley Oak Woodland	20	<1%	20	<1%
Marsh	83	<1%	83	<1%
Blackberry Scrub	11	<1%	11	<1%
Total Riparian Vegetation	8,011	72%	8,011	72%
Total Land Surface Area	11,072		11,072	
Channel Surface Area	2,832		2,832	
Total	13,904		13,904	

GIC (1997; 2000). Percentages may not total due to rounding.

Colusa-Verona Reach

VEGETATION TYPE	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Riparian Forests	1,149	41%	1,149	41%
Riparian Scrub	176	6%	176	6%
Valley Oak Woodland	0	0%	0	0%
Marsh	6	<1%	6	<1%
Blackberry Scrub	4	<1%	4	<1%
Total Riparian Vegetation	1,335	47%	1,335	47%
Total Land Surface Area	2,816		2,816	
Channel Surface Area	1,891		1,891	
Total	4,707		4,707	

GIC (1997; 2000). Percentages may not total due to rounding

Appendix D: Acreage Tabulations

Part 3. Ownership.

Keswick-Red Bluff Reach

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	5,799	73%	15,067	82%
Public				
Federal	786	10%	1,556	8%
State	551	7%	945	5%
Local District, City, County	848	11%	906	5%
Total (Land Surface Area)	7,984	101%	18,474	100%
Channel Surface Area	3,005		3,005	
Total:	10,989		21,479	

DWR Sacramento River GIS (May 1994); DPR (1994). Rounded to nearest 100 acres.

Red Bluff-Chico Landing Reach

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	9,458	59%	25,309	74%
Public				
Federal	3,429	22%	5,327	16%
State	2,759	17%	3,201	9%
Local District, City, County	258	2%	270	<1%
Total (Land Surface Area):	15,904	100%	34,107	100%
Channel Surface Area	2,896		2,896	
Total	18,800		37,003	

DWR Sacramento River GIS (May 2000); DPR (1994). Rounded to nearest 100 acres.

Part 3. Ownership.

Chico Landing-Colusa Reach

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface
Area				
Private	7,437	67%	7,437	67%
Public				
Federal	1,092	10%	1,092	10%
State	2,523	23%	2,523	23%
Local District, City, County	20	<1%	20	<1%
Total (Land Surface Area):	11,072	100%	11,072	100%
Channel Surface Area	2,832		2,832	
Total	13,904		13,904	

DWR Sacramento River GIS (May 1994); DPR (1994); Conservation easement records kept by DWR. Rounded to nearest 100 acres.

Colusa - Verona Reach

OWNERSHIP CATEGORY	INNER RIVER ZONE GUIDELINE		CONSERVATION AREA	
	Acres	% of Land Surface Area	Acres	% of Land Surface Area
Private	2,754	98%	2,754	98%
Public				
Federal	0	0%	0	0%
State	53	2%	53	2%
Local District, City, County	9	<1%	9	<1%
Total (Land Surface Area):	2,816	100%	2,816	100%
Channel Surface Area	1,891		1,891	
Total	4,707		4,707	

DWR Sacramento River GIS (May 1994); DPR (1994); Conservation easement records kept by DWR. Rounded to nearest 100 acres.

Appendix D: Acreage Tabulations

Part 4. The Four Reaches

REACH	RIVER MILES	LENGTH	AREA WITHIN INNER RIVER ZONE GUIDELINE (acres)	AREA WITHIN CONSERVATION AREA (acres)
Keswick Dam-Red Bluff Diversion Dam	RM 302-RM 243	59 river miles	11,000	21,500
Red Bluff Diversion Dam-Chico Landing	RM 243-RM 193	50 river miles	18,800	37,000
Chico Landing-Colusa Bridge	RM 193-RM 144	49 river miles	14,000	14,000
Colusa Bridge-Verona ¹	RM 143-RM 79	64 river miles	4,700	4,700
Total:	RM 302- RM 79	223 river miles	48,500 acres	77,200 acres

Acres rounded to nearest 100.
¹ Confluence of the Feather River

**SENATE BILL 1086 AND SENATE CONCURRENT
RESOLUTION NO. 62**

Senate Bill No. 1086

CHAPTER 885

An act to add Article 4.5 (commencing with Section 1385) to Chapter 4 of Division 2 of, and to add and repeal Chapter 4.5 (commencing with Section 1400) of Division 2 of, the Fish and Game Code, relating to the Upper Sacramento River Fisheries and Riparian Habitat, and making an appropriation therefor.

[Approved by Governor September 18, 1986. Filed with Secretary of State September 18, 1986.]

LEGISLATIVE COUNSEL'S DIGEST

SB 1086, Nielsen. Upper Sacramento River: fisheries and riparian habitat.

(1) Under the Wildlife Conservation Law of 1947, the Wildlife Conservation Board may authorize the Department of Fish and Game to acquire real property for the benefit of wildlife.

This bill would require the board by January 1, 1988, to inventory the lands along the upper Sacramento River, as described, to identify and determine the priority of those lands that are valuable to fish and wildlife. The bill would prescribe related matters.

(2) Existing law does not provide for an Upper Sacramento River Fisheries and Riparian Habitat Advisory Council.

This bill would create that council composed of specified members, and would require the advisory council to develop, for submission to the Legislature, the Upper Sacramento River Fisheries and Riparian Habitat Management Plan to provide for the protection, restoration, and enhancement of fish and riparian habitat and associated wildlife for the area between the Feather River and Keswick Dam. The bill would provide for an action team with specified members to develop proposed plan elements. The bill would specify related requirements for preparation of the management plan. The bill would require the advisory council to submit the management plan to the Legislature by January 1, 1989. These provisions of the bill would be repealed on January 1, 1989.

(3) The bill would appropriate \$250,000 from the California Environmental License Plate Fund, with \$150,000 to the Wildlife Conservation Board for the inventory and \$100,000 to the Secretary of the Resources Agency for the preparation of the management plan.

Appropriation: yes.

The people of the State of California do enact as follows:

SECTION 1. Article 4.5 (commencing with Section 1385) is added to Chapter 4 of Division 2 of the Fish and Game Code, to read:

Article 4.5. Lands Inventory

1385. For the purposes of this article, "upper Sacramento River" means the Sacramento River upstream from the confluence with the Feather River and downstream from Keswick Dam.

1386. The board shall, not later than January 1, 1988, inventory, or cause to be inventoried, the lands along the upper Sacramento River to identify and determine the priority of those lands that are valuable to fish and wildlife. The inventory shall be conducted so as to provide information needed to make evaluations pursuant to this chapter.

1387. The inventory made under this article shall take special efforts to identify lands that provide any of the following:

- (a) A source of salmon spawning gravels, or lands that are otherwise important to anadromous and resident fisheries.
- (b) Habitat for rare, threatened, and endangered species.
- (c) Riparian habitat or an opportunity for reestablishment of riparian habitat.

1388. The board shall also make a preliminary identification of potential willing sellers in the inventory made under this article.

SEC. 2. Chapter 4.5 (commencing with Section 1400) is added to Division 2 of the Fish and Game Code, to read:

CHAPTER 4.5. UPPER SACRAMENTO RIVER FISHERIES AND RIPARIAN HABITAT MANAGEMENT PLAN

1400. The Legislature hereby finds and declares as follows:

(a) The Sacramento River system has tremendous social, environmental, and economic value to the people of California for many consumptive and nonconsumptive beneficial purposes. The Sacramento River system provides water for agricultural, municipal, and industrial uses, and for hydroelectric power, recreation, and navigation.

(b) The Sacramento River system is the state's largest producer of salmon, striped bass, sturgeon, and shad. It is also a major source of steelhead and other game fish and the source of water for much of the migratory bird population of the Pacific Flyway. It is essential that these values be protected.

(c) Various human and natural causes have contributed to substantial reductions in various anadromous fish populations in the Sacramento River system.

(d) Lack of a comprehensive management plan for the Sacramento River Basin has resulted in independent actions that pit some beneficial uses of water against others, thereby causing strong competition among competing water users.

(e) A comprehensive Upper Sacramento River Fisheries and Riparian Habitat Management Plan is needed to develop

information to provide for the protection, enhancement, and restoration of fish and riparian habitat and associated wildlife, as part of the orderly development of the water resources of the Sacramento River Basin for all beneficial purposes.

1401. As used in the chapter:

(a) "Advisory council" means the Upper Sacramento River Fisheries and Riparian Habitat Advisory Council created pursuant to Section 1402.

(b) "Action team" means the Upper Sacramento River Fisheries and Riparian Habitat Action Team created pursuant to Section 1403.

(c) "Management plan" means the Upper Sacramento River Fisheries and Riparian Habitat Management Plan prepared pursuant to this chapter.

1402. The Upper Sacramento River Fisheries and Riparian Habitat Advisory Council is hereby created consisting of the following members:

(a) The Director of Fish and Game, the Director of Water Resources, a designee of the State Lands Commission, a designee of the Chairperson of the State Water Resources Control Board, a designee of the Wildlife Conservation Board, and a designee of the Chairperson of the State Reclamation Board.

(b) The Director of the Mid-Pacific Region of the United States Bureau of Reclamation; the Sacramento District Engineer for the United States Army Corps of Engineers; the Regional Director, Region 1, for the United States Fish and Wildlife Service; the Regional Forester, Region 5, for the United States Forest Service; the State Director, California State Office, United States Bureau of Land Management; and the Regional Director, Region 3, for the National Marine Fisheries Service; provided that the foregoing federal officials agree to serve on the advisory council.

(c) One member of the board of supervisors, selected by the board of supervisors, from each of the following counties: Butte, Colusa, Glenn, Shasta, Sutter, and Tehama, provided that the county designates a board member to serve on the advisory council.

(d) Three persons, appointed by the Director of Fish and Game, who shall represent, respectively, commercial fishermen, recreational fishermen, and general wildlife and conservation interests. The Director of Fish and Game shall also appoint a representative of county government from a county not represented pursuant to subdivision (c) which contains a commercial fishing industry dependent on the upper Sacramento River. This person shall represent the commercial fishing industry interests of the San Francisco Bay area and north coast.

(e) One person, appointed by the Director of Forestry, who shall represent commercial timber operators.

(f) One person, appointed by the Director of Food and Agriculture, who shall represent agricultural interests and is a riparian landowner.

(g) A representative of the Sacramento River Water Contractors Association, provided that the representative agrees to serve on the advisory council.

1403. The Upper Sacramento River Fisheries and Riparian Habitat Action Team shall consist of one person designated by each member of the advisory council, except that the Chairperson of the California Regional Water Quality Control Board for the Central Valley Region shall designate one member and the Chairperson of the State Water Resources Control Board shall not designate a member and except that the members of the advisory council appointed pursuant to subdivisions (d), (e), and (f) of Section 1402 shall themselves serve on the action team.

1404. The advisory council and the action team shall each select a chairperson from its members by majority vote.

1405. Members of the advisory council and the action team shall serve without compensation.

1406. The advisory council shall develop the Upper Sacramento River Fisheries and Riparian Habitat Management Plan, including a proposed implementation program, for submission to the Legislature. The management plan shall provide for the protection, restoration, and enhancement of fish and riparian habitat and associated wildlife. The management plan shall establish a series of priority actions with specified time frames, estimated costs and benefits, and proposed funding sources.

The action team and the advisory council shall consider and may incorporate into the management plan, where feasible, the findings and recommendations of studies conducted by the Department of Water Resources pursuant to Section 238 of the Water Code.

1407. The area of study of the management plan shall be the Sacramento River and tributary streams, and associated riparian habitat, upstream from the confluence with the Feather River and downstream from Keswick Dam.

1408. The action team shall serve as a working group to develop proposed plan elements. The action team shall submit its recommendations to the advisory council for its review and approval. The advisory council shall be responsible for the management plan submitted to the Legislature.

1409. The Secretary of the Resources Agency shall appoint a project manager to supervise plan preparation and to coordinate activities of the advisory council and the action team.

1410. The advisory council shall hold at least two public hearings in separate counties within the area of study prior to final approval of the management plan. The action team shall hold at least one workshop, open to the public, in each of the counties represented on the advisory council pursuant to subdivision (c) of Section 1402.

1411. The advisory council shall submit the management plan, including a proposed implementation program, to the Legislature not later than January 1, 1989.

1412. This chapter shall not delay or preclude any current, pending, planned, or proposed fisheries and wildlife protection enhancement, restoration, or acquisition activities or bank protection, flood control, irrigation, or other management activities along the upper Sacramento River.

1413. This chapter shall remain in effect only until January 1, 1989, and as of that date is repealed, unless a later enacted statute, which is enacted before January 1, 1989, repeals or extends that date.

SEC. 3. The sum of two hundred fifty thousand dollars (\$250,000) is hereby appropriated from the California Environmental License Plate Fund for expenditure in accordance with the following schedule:

(a) One hundred fifty thousand dollars (\$150,000) to the Wildlife Conservation Board for the purposes of Article 4.5 (commencing with Section 1385) of Chapter 4 of Division 2 of the Fish and Game Code.

(b) One hundred thousand dollars (\$100,000) to the Secretary of the Resources Agency for preparation of the Upper Sacramento River Fisheries and Riparian Habitat Management Plan pursuant to Chapter 4.5 (commencing with Section 1400) of Division 2 of the Fish and Game Code.

Senate Concurrent Resolution No. 62

RESOLUTION CHAPTER 173

Senate Concurrent Resolution No. 62—Relative to the Sacramento River.

[Filed with Secretary of State September 21, 1989.]

LEGISLATIVE COUNSEL’S DIGEST

SCR 62, Nielsen. Sacramento River: Upper Sacramento River Fisheries and Riparian Habitat Management Plan.

This measure would declare that it is the policy of the State of California to implement the actions recommended in the Upper Sacramento Fisheries and Riparian Habitat Management Plan, as specified. The measure would request the Secretary of the Resources Agency to establish, for a 2-year period of service, an Upper Sacramento River Advisory Council, as prescribed.

WHEREAS, The Sacramento River system has tremendous social, environmental, and economic value to the people of California for many consumptive and nonconsumptive beneficial purposes; and

WHEREAS, The Sacramento River system is the largest source of salmon, striped bass, sturgeon, and shad in the state, and is also a major source of steelhead and other game fish; and

WHEREAS, The Sacramento River system is the source of water for much of the migratory bird population of the Pacific Flyway; and

WHEREAS, Various human and natural causes have contributed to substantial reductions in various anadromous fish populations in the Sacramento River system; and

WHEREAS, The California Legislature enacted legislation in 1986 which created an action team and an advisory council representing diverse interests to develop an Upper Sacramento Fisheries and Riparian Habitat Management Plan; and

WHEREAS, The advisory council completed and submitted a management plan to the Legislature in January of this year; and

WHEREAS, The plan identified specific actions necessary to protect, restore, and enhance the fisheries and riparian habitat and associated wildlife as part of the orderly development of the water resources of the Sacramento River Basin; now, therefore, be it

Resolved by the Senate of the State of California, the Assembly thereof concurring, That it is the policy of the state to implement the actions recommended in the Upper Sacramento River Fisheries and Riparian Habitat Management Plan in general conformance with the priorities indicated in the plan; and be it further

Resolved, That it is the policy of the state to appropriate sufficient funds annually, in conjunction with the federal government, local governments, and other sources, to implement the actions outlined in the management plan; and be it further

Resolved, That it is the policy of the state that departments, agencies, and other units of the state with responsibilities for implementation of the plan, shall upon adoption of this resolution, proceed with implementation measures that are authorized under existing law or as may be authorized in the future; and be it further

Resolved, That it is the policy of the state to encourage the federal government, local governments, and other organizations and individuals to proceed with their responsibilities to implement the actions outlined in the management plan; and be it further

Resolved, That the Secretary of the Resources Agency is hereby requested to establish, for a 2-year period of service, a multidisciplinary Upper Sacramento River Advisory Council, as recommended in the management plan, to review progress on the overall plan as it is implemented and to make annual recommendations on priorities and schedules to the Legislature and the United States Congress, as project actions are undertaken; and be it further

Resolved, That the Secretary of the Senate transmit a copy of this resolution to the Secretary of the Resources Agency.

Report on Costs

SACRAMENTO RIVER CONSERVATION AREA

c/o CALIFORNIA DEPARTMENT OF WATER RESOURCES
2440 MAIN STREET
RED BLUFF, CALIFORNIA 96080
www.sacramentoriver.ca.gov
Denny Bungarz, Advisory Council Chair • (530) 934-7342 • dbungarz@glenncounty.net
Burt Bundy, Coordinator • (530) 528-7411 • bundy@water.ca.gov



December 8, 1999

Mr. Denny Bungarz, Chair
Sacramento River Advisory Council
526 West Sycamore Street
Willows, California 95988

Dear Mr. Bungarz:

Enclosed please find the *Riparian Habitat Committee Report on Costs of Easements, Acquisitions, Restoration and Bank Protection along the Sacramento River*.

At the March 10, 1999 meeting of the SB1086 Riparian Habitat Committee's management subcommittee, I was asked to work with the California Department of Water Resources Northern District to gather general cost estimates for several riparian habitat management tools that are outlined in the *Handbook*, and to develop a map of a "hypothetical river bend" showing how and where such tools might be used. These tools include bank protection, easements (including a "set-aside" program), acquisition and both active (cultivated) and passive (natural recruitment) restoration. The report is to be included as Appendix G in the *Sacramento River Conservation Area Handbook*, and is referred to in the Memorandum of Agreement Regarding the Sacramento River Conservation Area.

This report provides general information only. The cost of land and easement acquisitions are based on recent sales. Details on these sales can be obtained from SB1086 staff at DWR.

The Riparian Habitat Committee reviewed a draft of this report in subcommittee on June 15, 1999, and at its July 14, 1999 regular meeting. The attached report includes changes and comments made during those meetings.

We hope that this report will provide stakeholders with a better understanding of costs associated with riparian habitat restoration conducted under a Sacramento River Conservation Area Program, as well as a useful starting point for site-specific planning and project implementation.

Sincerely,

Burt Bundy
Sacramento River Conservation Area Coordinator

**Report on Costs of Easements, Acquisitions, Restoration and Bank Protection
within the Sacramento River Conservation Area**

**by the
SB1086 Advisory Council
Riparian Habitat Committee
and the
Sacramento River Conservation Area Coordinator**

December 15, 1999

Introduction

The Sacramento River Conservation Area Handbook describes several tools available to restore and protect a continuous riparian corridor along the river. These include bank protection, easements (including a “set-aside” program), acquisition and both active (cultivated) and passive (natural recruitment) restoration. This report provides general cost estimates for each tool under various conditions (Table 1). In addition, the report provides an example of how and where such tools might be used on a hypothetical river bend (Figure 1).

The purpose of this report is to illustrate how the Sacramento River Conservation Area program would use restoration and management tools, and to illustrate the approximate proportion of funding that may be required for various aspects of a site-specific management plan.

To obtain background information, telephone interviews were held with people from a variety of organizations and agencies that currently use these tools. The basis for the actual cost estimates varies by tool. Land and easement acquisition costs are based on recent sales. These were compared with listing prices on the Internet and in the newspaper. Bank protection costs are based on discussions with two ranch managers, and on data provided by the U.S. Army Corps of Engineers (USACE). Set aside costs are based on rental rates for various crops. Restoration costs are based on estimates provided by two nonprofit restoration organizations. Each tool has a high degree of cost variation, as described below. Each section of the river is unique, and the cost of each of the implementation tools varies with the circumstances.

This report does not cite specific sources, because the Riparian Habitat Committee is concerned about protecting their privacy. However, source information can be obtained from 1086 staff at the Department of Water Resources, Northern District office.

Bank Protection

The Sacramento River Conservation Area program may use bank protection to achieve its goals, as described in the Handbook on page 9-6. The cost of both private and public bank protection along the Sacramento River is examined. Two river ranch managers in Tehama County with recent experience installing bank protection provided information on private costs, which ranged between \$150 and \$450 per linear foot. Cost depends on the height and slope of the bank, which alters the amount of rock needed per linear foot. Cost also depends on the environmental mitigation factors, including obtaining permits, working at night, and working around trees.

The USACE installs all of the publicly funded bank protection on the Sacramento River, under several authorities:

- Sacramento River Bank Protection Project (SRBPP), for purposes of protecting the proper functioning of the Sacramento River Flood Control Project;
- Chico Landing to Red Bluff Project, for purposes of preventing siltation downstream and in the delta, and
- Public Law 84-99, for emergency flood control purposes.

Cost of publicly-installed bank protection was obtained from the USACE, Sacramento District. Costs of two bank protection sites, the lower American River, and Steamboat Slough (both installed under SRBPP authority), were considered representative of the current range of costs of bank protection. These projects cost \$2,000 and \$1,000 per linear foot respectively. However, many of the proposed future sites may be \$2,500 or more per linear foot given the high mitigation costs required for these sites.

Cost of installing emergency bank protection under PL 84-99 (such as that installed in Butte County in the winter of 97/98) was not determined.

Trenched rock figures (Figure 1) were based on costs experienced by one landowner who has installed periodically beginning in the late 1980s. His costs have been \$85-125 per linear foot, based on a 12'x12' trench filled with free concrete rubble. Costs included digging the trench, filling, and transporting the rubble. No permit costs were incurred on the project.

Acquisition

The Sacramento River Conservation Area Program may use fee title acquisition to achieve its goals, as described in the Handbook on pages 9-6 and 9-7.

Acquisitions for riparian habitat conservation and flood control purposes have been made by private conservation organizations such as The Nature Conservancy (TNC), as well as the U.S. Fish and Wildlife Service (USFWS), the Bureau of Land Management, the Wildlife Conservation Board (WCB) and The Reclamation Board (Rec Board).

Cost estimates are based on actual sales of properties to the USFWS and two nonprofit land restoration organizations that work on the Sacramento River. Costs were compared with Internet and classified listings of land for sale on or near the Sacramento River. Acquisition prices were divided into land use type, with walnut orchards ranging between \$6,000 and \$10,000 per acre, almond and prune orchards ranging between \$4,500 and \$7,500 per acre, non-irrigated crops (grainland) ranging between \$2,000 and \$3,000 per acre, irrigated row crops ranging between \$2,500 and \$3,500 per acre, existing riparian habitat ranging between \$800 and \$1,200 per acre, and gravel bars ranging between \$500 and \$800 per acre. Reasons for variation in costs for each land use type include condition of the land, production records and location of the property.

Conservation Easements

The Sacramento River Conservation Area program may use conservation easements and set-aside agreements to achieve its goals, as described in the Handbook on pages 9-4 through 9-6.

Both agricultural conservation and riparian conservation easements have been purchased by the WCB, The Rec Board, and TNC. Riparian conservation easements are deeded easements that have significant restrictions on land use, including prohibition of development for agricultural, residential, commercial and industrial uses, and also limits on such activities as flood control, water use and gravel or mineral

removal. Continued control of hunting and access may be reserved for the landowner.

Agricultural conservation easements are deeded easements that allow agricultural uses, but prohibit residential, commercial, and industrial development. Restrictions as to some crop uses and the incorporation of an integrated pest management (IPM) plan are usually included. Sometimes a "best management practices (BMP)" section is included. All other normal agricultural uses are reserved for the landowner.

Easement costs in this report are based on prices paid by the WCB for three separate conservation easements purchased in 1987, 1993 and 1994. These easements are on both agricultural and riparian land. Prices for easements on agricultural land averaged between \$600 and \$5,000 per acre, based on an easement in Colusa County at river mile 145. Prices for easements on riparian lands along the Sacramento River ranged between \$400 and \$900 per acre, based on an easement near Hamilton Bend in Colusa County. Prices for these easements varies greatly depending on current land market values, date of purchase, type and condition of land, and the nature of the restrictions placed on the land in the easement agreement.

A set-aside program is described in the Handbook which would be similar to an easement, but would be a renewable contract with the landowner rather than the outright purchase of an easement. Programs similar to this include the Conservation Reserve Program offered through Natural Resources Conservation Service and a set aside program involving asparagus in the delta, that uses a percentage of average production revenues as a basis for determining annual payment. This method is also used to determine rental rates for cropland. The annual set-aside costs of \$50 to \$300 per acre in this report are based on rental rates for various crops grown along the Sacramento River.

Restoration

Restoration of riparian forests is part of the overall goal of the Sacramento River Conservation Area Program. Restoration priorities are listed on pages 1-6 - 1-7 of the Handbook.

Restoration is being carried out by local, state and federal agencies and non-profit organizations along the river. The largest efforts are being carried out by TNC, which has restored over 2,000 acres.

Costs of land restoration along the Sacramento River were obtained from two restoration organizations working on the river. Restoration methods on the Sacramento River can be grouped as active (cultivated) or passive (natural recruitment). Passive restoration costs run from negligible amounts to \$1,000 per acre, depending on the level of land use and the existing infrastructure. Uses such as farming and gravel mining tend to require minimal restoration, while lands that contain extensive weeds and/or levees that need to be removed require a more intensive and costly restoration. Active restoration costs range from \$2,000 to \$5,000 per acre and this depends on the intensity of the current land use and the cost to discontinue that use. Controlling weeds, irrigation, and the planting of both over- and understory species all contribute to the high end of the cost range.

Table 1. Cost Estimates

	Cost Estimate (Low)	Cost Estimate (High)	Factors Affecting Cost Variation
BANK PROTECTION	(per linear foot)	(per linear foot)	
Federal--USACE (Rock)	\$1,000	\$2,000	bank height, bank slope; environmental factors (e.g. working at night, working around trees obtaining permits, etc.)
Private (Rock)	\$150	\$450	
Private (Trenched Rock)	\$85	\$125	cost based on 12'x12' trench, with free concrete rubble fill
CONSERVATION EASEMENTS	(per acre)	(per acre)	
Riparian	\$400	\$900	market values, date of acquisition, land conditions, land restrictions
Agricultural	\$600	\$5,000	market values, date of acquisition, land conditions, land restrictions
Setasides	\$50	\$300	rental prices for various crops
ACQUISITIONS (by land use type)	(per acre)	(per acre)	
Orchard (almond/prune)	\$4,500	\$7,500	vary with location, soil quality, flood risk, etc.
Orchard (walnut)	\$6,000	\$10,000	vary with location, soil quality, flood risk, etc.
Non-irrigated Crops (Grainland)	\$2,000	\$3,000	vary with location, soil quality, flood risk, etc.
Row Crops (irrigated)	\$2,500	\$3,500	vary with location, soil quality, flood risk, etc.
Existing Riparian	\$800	\$1,200	vary with location, soil quality, flood risk, etc.
Gravel Bars	\$500	\$800	vary with location, soil quality, flood risk, etc.
RESTORATION	(per acre)	(per acre)	
Recruitment	\$0	\$1,000	cost varies greatly due to site-specific issues, such as weed control, levee removal, cost of discontinuing existing uses
Cultivated	\$2,000	\$5,000	cost varies greatly due to site-specific issues, such as weed control, levee removal, cost of discontinuing existing uses, complexity of planting design, and irrigation and maintenance.

ESTIMATES ARE BASED ON ACTUAL COSTS (1987-1999). SOURCES ARE AVAILABLE FROM DWR NORTHERN DISTRICT.

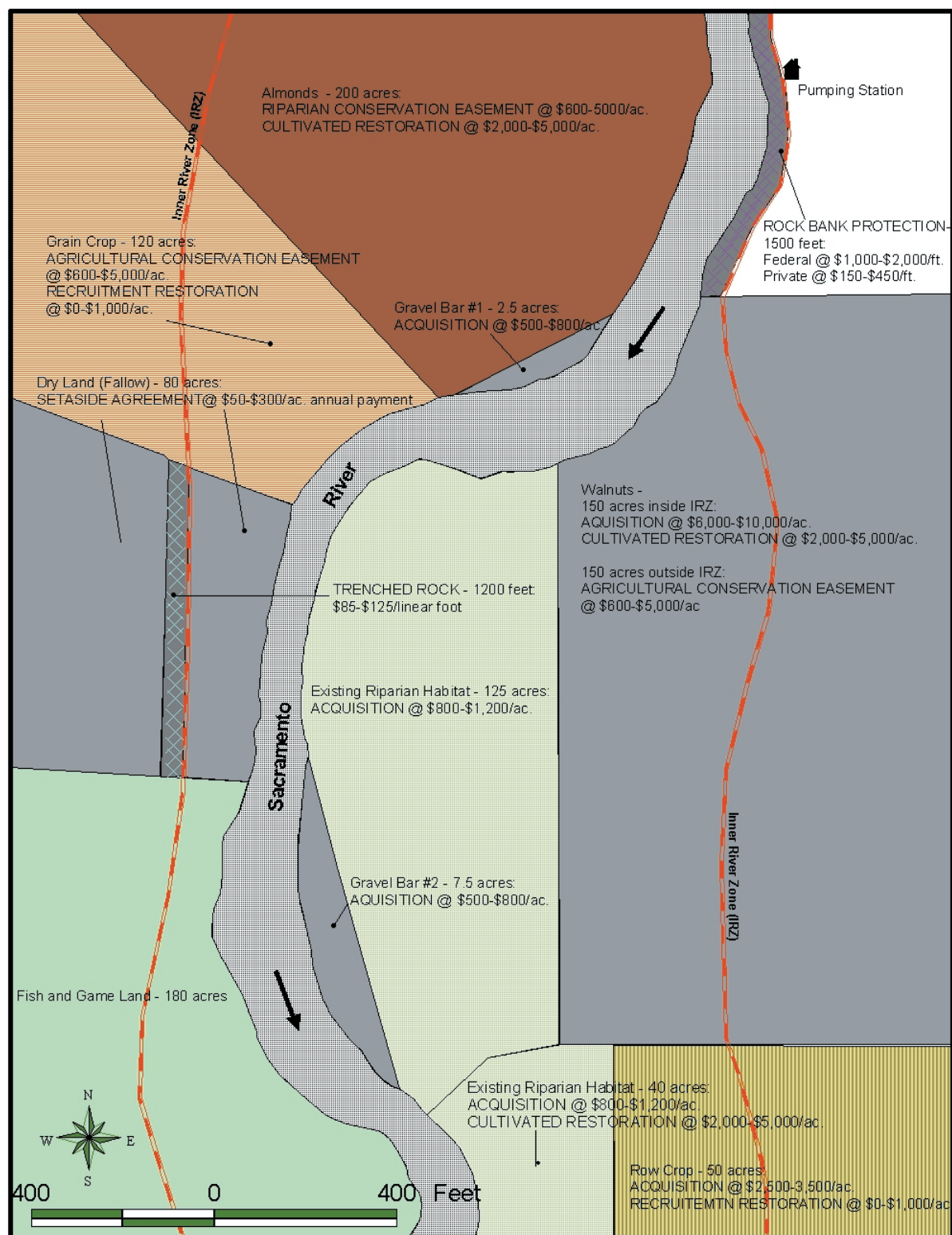


Figure 1. Hypothetical river bend, showing use of some of the tools outlined in the Handbook. Each section of the river is unique and the cost of these actions vary with the circumstances. Estimates are based on actual costs (1987-1999). Sources are available from DWR Northern District.

d:\data\sb1086\handbook\december1999revisions\final\river_model_julie_rev.apr
M. Kelly & J. Cunningham 12/16/99



AMENDMENT PROCEDURE

HANDBOOK AMENDMENT PROCEDURE

The Sacramento River Conservation Area Handbook is the result of many hours of work by the Riparian Habitat Committee and members of the Department of Water Resources staff. As this is a working document, amending it to keep it up to date and to correct any errors is an essential part of the process.

1. Amendments to the Handbook will be reviewed at least annually, as determined by the Board, at a regularly set amendment review meeting of the Sacramento River Conservation Area Board of Directors.
2. Proposed amendments shall be presented to the SRCA Board in writing. The suggested changes or corrections should indicate the chapter and page affected and be submitted using “strike out” and “underline” format. The person or group proposing the change should list the reasons for the amendment and be prepared to address the need for the proposed change at the appropriately scheduled SRCA meeting.
3. Upon receiving a proposed amendment, the SRCA Board will refer it to the Technical Advisory Committee for review and recommendation to the Board. The proposed amendment will also be assigned to the agenda of the next SRCA meeting, after the Technical Committee review, for discussion and possible action. Action may include denial or acceptance of the amendment, or a modification of the amendment, for recommendation to adopt at the amendment review meeting.
4. At least thirty days prior to the scheduled amendment review meeting, the SRCA Board will notify the signatories of the MOA and the members of the Advisory Council of the Board’s intent to adopt specific Handbook amendments.
5. Amendments to the Handbook will be adopted by a vote of the Board as defined in the MOA.

The changes will be published once each year at a time established by the SRCAF. All adopted changes will be incorporated into the Handbook and sent to all identified Handbook owners. To the extent funding and staff resources allow, DWR will assist the SRCA in publishing and distributing changes to the Handbook.

GLOSSARY

accretion: Sediments carried by a stream and deposited along banks or surrounding areas.

active restoration: Specific, human actions taken to reestablish the natural processes, vegetation and resultant habitat of an ecosystem.

aggrade (aggradation): To raise the channel of a river by depositing sediment and similar materials.

alluvial: Pertaining to clay, silt, sand, gravel or other sedimentary matter deposited by flowing water, usually within a river valley.

anabranch: A channel that branches off from a river (often creating islands), re-joining it further downstream.

anadromous: Pertains to fish species that spend a portion of their life cycle in the ocean, but that migrate to fresh water to spawn.

bank protection: A method of erosion control in which materials (usually rock revetment) are placed along the banks of a river in order to prevent encroachment on adjacent land.

bank stabilization: The prevention of channel migration through bank protection.

basin: An area drained by a river and its tributaries.

bottomlands: The low alluvial lands next to a river.

Central Valley Project (CVP): Agricultural water supply system that is operated and maintained by the Federal Bureau of Reclamation; water from the Sacramento River is captured and conveyed from Lake Shasta to the San Joaquin Valley.

channel migration: The lateral movement of a river channel as it adjusts to balance erosion with deposition.

channel: The space above the bed and between the banks occupied by a natural or artificial waterway that confines water.

chute cutoff: A channel that connects the converging areas of a meander bend; a chute cutoff creates an oxbow lake from an existing meander bend.

conservation easement: Legally binding restrictions that landowners voluntarily place on their properties that bind present and future owners; these restrictions limit certain rights and uses of the property for conservation, preservation or restoration purposes.

degrade (degradation): Opposite of aggrade (aggradation); to erode or deepen a river channel.

designated floodway: The river channel and that portion of the adjoining floodplain required to reasonably provide passage for the 100-year flood (defined by State Reclamation Board).

distributary: A branch of a river that flows away from the main river channel without rejoining it.

ecosystem: A community of different species interacting with one another and their environment.

endangered species: A species with so few surviving individuals that it is in danger of becoming extinct.

ephemeral: Lasting a short time; a stream that does not flow year round.

extirpation: Local extinction or complete disappearance of a species from a region.

floodplain: The relatively flat area along the sides of a river which is naturally subject to flooding.

floodway: The river zone that could theoretically (based on surveying data and hydraulic calculations) convey the 100-year flood with only a one-foot rise of water level above the height of the unconfined flood; construction is generally prohibited in these areas.

fluvial: Pertaining to a river.

forb: An herb that is not considered to be a grass or grasslike.

geomorphology: The study of the origins, processes and characteristics of land-forms.

habitat: The environment of a plant or animal species.

hard points: Structures located adjacent to a river, such as buildings, bridges or levees, that change the direction or rate of channel migration by interfering with the river's movement.

hydrology: The science concerned with the properties, distributions and characteristics of the water in relation to the earth.

incidental take: The loss or harassment of a listed species or degradation of their habitat incidental to an otherwise lawful activity.

inner river zone: The estimated portion of river alluvium that has experienced river channel migration in the recent past and is likely to experience channel movement in the near future; the area includes the 100-year meanderbelt and areas of projected bank erosion over the next fifty years.

lagoon: Any small, pond-like body of water that may or may not be connected to a larger body of water.

levee: An embankment designed to prevent the flooding of a river; may be natural or human made.

levee toe: The outer edge of the levee base where it meets the levee grade.

limited meander: Allowing for river channel migration within a defined area.

marshlands: Wet areas of land dominated by typical wetland species, such as grasses and tule or cattails.

meander: The bend or curve in a river or stream channel. Also refers to the migration of the river or stream channel.

meander scar: The area of land marked by the earlier presence of a meandering river channel.

mitigation: An action designed to avoid, minimize, reduce or compensate for a significant impact to the environment.

natural levee: naturally occurring deposits along the sides of a river that constrain frequent floods.

neotropical migrants: Species, typically birds, that migrate to and from the tropical regions of North America, South America and the West Indies.

non-point source pollution: Water pollution deriving from a broad area rather than a specific place; for example, urban and agricultural runoff may contain non-point source pollutants.

one-hundred-year floodplain: The relatively flat portion of the river channel that has a one percent chance of being inundated by flood waters in any given year.

one-hundred-year meanderbelt: The area of land over which a river channel has historically migrated over a 100-year period.

oxbow lake: A horseshoe-shaped lake formed in an abandoned meander bend of a river.

passive restoration: Allowing a river system to restore its natural vegetation and processes without human help or interference (opposite of active restoration).

phreatophyte: Plant that draws water from saturated soils typically found in river floodplain

reforestation: The replanting of trees in an area that was previously forested.

regulated floodway: The channel of a river or other watercourse and the adjacent land areas that must be reserved for the discharge of the base flood without cumulatively increasing the water surface elevation by more than one foot.

restoration: The return of an ecosystem to an approximation of its former unimpaired condition.

riparian: Pertaining to the banks of a stream, such as riparian woodland or riparian vegetation.

riparian habitat: An area composed of native riparian vegetation that provides habitat for wildlife.

riparian corridor: A band of native riparian vegetation, or frequently flooded land, of variable width, adjacent to a river channel.

river gradient: The slope of a river's water surface profile.

rock revetment: A layer of rock designed to protect a river embankment.

Sacramento River Conservation Area (SRCA): The 222 miles of the Sacramento River and the adjacent 77,155 acres of land extending from Keswick Dam in Shasta County south to the town of Verona in Sutter County.

Senate Bill 1086 (SB 1086): Legislation authored by Senator Jim Nielsen that authorized the formation of the SB1086 Advisory Council to oversee issues related to the Sacramento River.

sensitive species: A plant or animal species listed by the state or federal government as threatened, endangered or as a species of special concern. SEE ALSO: threatened species, endangered species.

seral stages: Ecological communities that succeed one another in the biotic development of an area.

set-aside agreements: Short-term (5-year minimum) restrictions self-imposed by landowners that bind present as well as future owners, that enables land management with minimum interference; a contract, generally including the same types of conditions found in conservation easements, however, landowners could reserve the right to conduct limited agricultural and non-commercial activities within the set-aside area.

set-back levee: Levees that are constructed at a distance from the river channel in order to allow the river to occupy a portion of its floodplain; these levees are usually smaller in size than levees placed immediately adjacent to the river channel. SEE ALSO: levee, natural levee.

sinuous: Having many curves, bends or turns, such as a meandering river.

slough: A naturally occurring side or overflow channel that holds water.

snag: A dead tree or part of a tree, such as a stump, located in a river channel

State Water Project (SWP): The water storage and conveyance system that is operated and maintained by the California Department of Water Resources.

subreach: A general term used to describe a portion of a river reach.

succession: The replacement of one plant community by another over time.

threatened species: A species that is still abundant in its natural range but may become endangered if it declines in number.

trenched rock: A method of erosion control accomplished by burying rock or structural fill in an area set back from the main river channel; similar to windrowed rock.

tributary: A stream or body of water that flows into a larger body of water, such as a larger river.

understory: Underlying, low vegetation often including shrubs, small trees, grasses and forbs.

Upper Sacramento River Fisheries and Riparian Management Plan: Plan completed in 1989 by the SB1086 Advisory Council which recommends specific actions to be taken on the Sacramento River to restore fisheries and riparian habitat.

watershed: The total area above a given point on a watercourse that contributes water to its flow; the entire area from which a river receives its water supply. Also referred to as catchment or catchment basin.

weir: A notch or depression in a dam or other water barrier through which the flow of water is either measured or regulated.

wetland: Lands that are transitional between terrestrial and aquatic systems where water is usually at or near the surface or the land is covered by shallow water (typically streams, lakes and the open ocean).

windrowed rock: A method of erosion control where rock is piled in an area where the channel is likely to erode; theoretically, when erosion reaches the windrow, the rock will fall along the bank, increasing its stability; similar to trenched rock.

Appendix I

Appendix I “Issues To Be Resolved” has been deleted from the 2002 Handbook.

MEMORANDUM OF AGREEMENT

**MEMORANDUM OF AGREEMENT
REGARDING THE SACRAMENTO RIVER CONSERVATION AREA**

I. Preamble

Background

In 1986, the California State Legislature passed Senate Bill 1086. The law called for development of a management plan for the Sacramento River and its tributaries to protect, restore, and enhance both fisheries and riparian habitat.

The law created an Advisory Council, composed of representatives of state and federal agencies, county supervisors, and landowner, water contractor, commercial and sport fishery, and general wildlife and conservation representatives. The Council and its action teams developed a plan which included a specific and action-oriented fisheries plan, and a more conceptual riparian habitat plan. This plan, the Upper Sacramento River Fisheries and Riparian Habitat Management Plan, was published by the State of California Resources Agency in 1989 (*1989 Plan*).

Many of the fisheries action items have since been or are currently being implemented, such as fish bypass structures at diversions on Sacramento River tributaries, and the Shasta Dam temperature control structure. A Riparian Habitat Committee was created in 1993, when the Advisory Council was reconvened by the Secretary of Resources to “complete its earlier work concerning riparian habitat protection and management, including the development of a specific implementation program.”

The Riparian Habitat Committee is an informal and consensus-based planning group. It includes landowner representatives, environmental group leaders, and agency personnel who are working toward on-the-ground implementation of the *1989 Plan*. They have developed *The Sacramento River Conservation Area Handbook (Handbook)* as a guide for riparian habitat management along the Sacramento River. The Committee has worked to ensure that the Handbook addresses both the dynamics of riparian ecosystems as well as the realities of local agricultural economies.

Through the work of the Riparian Habitat Committee, the Advisory Council proposes the formation of a largely locally-based nonprofit entity to coordinate implementation of the riparian habitat management and restorations goals and objectives of the 1989 Plan and Handbook. Actions implemented by the nonprofit should also be coordinated with the Central Valley Project Improvement Act, the CALFED Bay-Delta Program, and the U.S. Army Corps of

Engineers Sacramento-San Joaquin Basins Comprehensive Study, and other ongoing related activities. The work of this nonprofit organization would be supported by the various agencies and organizations interested in the Sacramento River through this Memorandum of Agreement (MOA).

Goal of the Sacramento River Conservation Area Program

The goal of the Sacramento River Conservation Area Program as outlined in the *1989 Plan* is “to preserve remaining riparian habitat and reestablish a continuous riparian ecosystem along the Sacramento River between Chico and Redding, and reestablish riparian vegetation along the River from Verona to Chico.” The goal will be met in a manner that follows these six guiding principles:

- Utilizes an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander, where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Encourages participation by private landowners and affected local entities that is voluntary, never mandatory;
- Gives full consideration to landowner, public and local government concerns;
- Provides for the accurate and accessible information and education that is key to sound resource management.

II. Purpose of MOA and Disclaimers

The purpose of this MOA is to:

- A. Document broad endorsement by the signatories of the decisions and recommendations made by the Advisory Council embodied in the *1989 Plan*.
- B. Document signatory commitment to support the goals, six principles and *Handbook*.
- C. Improve coordination and cooperation between public agencies in the implementation of the *1989 Plan* and *Handbook*.

Appendix J: Memorandum of Agreement

- D. Identify the agreements of the signatories and relationships among the signatories and the new nonprofit organization (NPO) in implementing the *1989 Plan* and *Handbook*.
- E. Document signatory support of the establishment of a NPO as described in *Goal, Role and Structure of a Nonprofit Organization* (Attachment A).
- F. Identify the role and responsibilities of the NPO as detailed in Attachment A.

Disclaimers

- A. Nothing in this MOA is intended to expand or limit the legal authority of any signatory, agency, entity or organization. This document does not modify or supersede other existing agreements, programs, MOUs, plans, regulations or executive orders.
- B. Nothing herein alters the existing authorities or responsibilities of any party nor shall be considered as obligating any party in the expenditure of funds or the future payment of money or providing services.
- C. This MOA is intended to embody general principles, and does not create contractual relationships, rights, obligations, duties or remedies between or among signatories.
- D. All activities implemented by the NPO under the *1989 Plan* and *Handbook*, including site specific agreements, will be in compliance with all applicable existing and future local, state, and federal laws and regulations.
- E. The signatories acknowledge that the California Environmental Quality Act requires consideration of the environmental consequences of an activity as early as feasible in the planning process to enable environmental considerations to influence project program and design. All activities implemented under the *1989 Plan* and *Handbook* will comply with CEQA and the National Environmental Policy Act (NEPA) on a site-specific basis. The signatories will also consider the appropriateness and potential benefits of programmatic approaches to CEQA and NEPA compliance.

III. Relationship between Signatories and Nonprofit Organization

- A. We will support the NPO in implementing the *1989 Plan* and *Handbook*, and will work with the NPO on specific projects. We will maximize coordination and consistency of policies and programs with the *1989 Plan* and *Handbook*.

- B. We will assist the NPO in identifying and obtaining funding sources for the activities of the NPO including, but not limited to, a voluntary land transaction or management program. This program may include activities such as development of site specific land management plans within the inner zone; bank stabilization that is consistent with the 1989 Plan and Handbook; re-vegetation of levees and other areas where natural revegetation will not occur; and control of trespass and vandalism.
- C. We will coordinate with the NPO in the land management planning process for lands within the Conservation Area delineated in the Handbook.
- D. We will coordinate with the NPO when acquiring lands within the Conservation Area delineated in the Handbook.
- E. We will conduct land management practices on public lands within the Sacramento River Conservation Area in a manner that is consistent with the 1989 Plan and Handbook.
- F. We may contract with the NPO.
- G. Signatories will work with the NPO to develop a streamlined/ coordinated permit process for individual project agreements.
- H. Appropriate signatories will participate in a technical advisory committee for the NPO. They will assist the NPO with technical information on issues such as erosion/deposition data, flood control activities, and habitat protection and restoration methods and programs.
- I. Appropriate signatories will work with the NPO to coordinate and maximize law enforcement activities regarding trespass and vandalism along the river and for participating properties within the Conservation Area on both private and public lands.

IV. General Agreements

- A. We endorse the goals of the 1989 Plan.
- B. We agree to the goals, six principles, and Handbook.
- C. We agree to maximize coordination and consistency of the programs and policies of our agencies with the goals, and management objectives in the 1989 Plan and Handbook.
- D. We agree to recognize the proposed Conservation Area as delineated and described in the Handbook.

- E. We recommend and agree to the creation of a NPO as detailed in Attachment A. The NPO will oversee implementation of the goals and restoration priorities stated in the 1989 Plan and Handbook.
- F. We agree that any potential breach of the inner zone boundary will be addressed quickly and with our full cooperation. The manner in which the breach will be addressed will depend on the specific site, and may range from the placement of rock or other appropriate material to the acquisition of land.

V. Amendment Process

This MOA may be supplemented, amended, or modified by the written agreement thereto of the signatories.

VI. Signatories

NOTE: Support for this MOA will be solicited and welcomed from each of the governments and agencies below. After signing the MOA, each county participant will appoint two representatives to the board of directors of the proposed nonprofit organization. The participation of four counties is required to ensure a large enough initial board. Italics indicate those state governments and agencies from whom signed support is critical for the success of the program.

Butte County
Colusa County
Glenn County
Shasta County
Sutter County
Tehama County
Yolo County
California Resources Agency
California Department of Fish and Game
Wildlife Conservation Board
California Department of Water Resources
California Department of Parks and Recreation
California Water Commission
The Reclamation Board
California State Lands Commission
California Department of Food and Agriculture
United States Army Corps of Engineers
United States Army Corps of Engineers
United States Bureau of Reclamation
United States Fish and Wildlife Service
United States Natural Resource Conservation Service

National Marine Fisheries Service
City of Redding
City of Anderson
City of Red Bluff
City of Tehama
City of Colusa
California Environmental Protection Agency
California Department of Forestry and Fire Protection
California Department of Boating and Waterways
California Department of Conservation
Special Districts (e.g. reclamation, flood control, irrigation districts etc.)
State Water Resources Control Board
Central Valley Regional Water Quality Control Board
United States Environmental Protection Agency
United States Bureau of Land Management
United States Forest Service

In addition to signed support from the above governments and agencies, endorsements will be sought from the following programs and organizations:

Audubon Society
CALFED Bay Delta Program
California Cattlemen's Association
California Farm Bureau Federation
Central Valley Habitat Joint Venture
California Waterfowl Association
CalTrout
Central Valley Flood Control Association
Ducks Unlimited
Family Water Alliance
Friends of the River
The Nature Conservancy
Northern California Water Association
Pacific Coast Federation of Fishermen's Associations
Planning and Conservation League
Riparian Habitat Joint Venture
Sacramento River Discovery Center
Sacramento River Partners
Sacramento River Preservation Trust
Sacramento River Watershed Program
Sacramento Valley Landowners Association
Society for Ecological Restoration, California Chapter
Trust for Public Lands
United Anglers of California

**MEMORANDUM OF AGREEMENT
REGARDING THE SACRAMENTO RIVER CONSERVATION AREA**

**ATTACHMENT A
Goal, Role and Structure of a Nonprofit Organization**

VI. Goal

The SB 1086 Advisory Council recommends the creation of a local nonprofit organization (NPO) to implement a Sacramento River Conservation Area Program as described in the Upper Sacramento River Fisheries and Riparian Habitat Management Plan (1989 Plan) and the Sacramento River Conservation Area Handbook (Handbook).

The goal of the NPO and the Sacramento River Conservation Area Program is to preserve remaining riparian habitat and reestablish a continuous riparian ecosystem along the Sacramento River between Chico and Redding, and reestablish riparian vegetation along the river from Verona to Chico. The goal will be met in a manner that follows these six guiding principles:

- Utilizes an ecosystem approach that contributes to recovery of threatened and endangered species and is sustainable by natural processes;
- Uses the most effective and least environmentally damaging bank protection techniques to maintain a limited meander, where appropriate;
- Operates within the parameters of local, state and federal flood control and bank protection programs;
- Encourages participation by private landowners and affected local entities that is voluntary, never mandatory;
- Gives full consideration to landowner, public and local government concerns;
- Provides for the accurate and accessible information and education that is key to sound resource management.

The following outlines the role and structure of the NPO.

II. Role

Numerous factors were identified as being critical in the creation of a management entity to implement the *1989 Plan* and *Handbook*. These responsibilities and factors, listed and described below, provide the basis for outlining the role of the NPO.

- Enhanced Communication
- Coordination and Consistency
- Voluntary Land Transactions
- Riparian Habitat Restoration
- Flood Management
- Land Management
- Limiting River Meander (including Bank Stabilization)
- Mitigation
- Public Information and Technical Assistance
- Public Safety and Law Enforcement on Public and Private Lands
- Monitoring and Research
- Funding Sources and Financial Authority

Enhanced Communication. The NPO will provide a forum to enhance communication among the numerous agencies and interests along the river. The NPO will serve as a liaison between landowners, conservationists and local, state and federal agencies. The NPO will assist with conflict resolution regarding property management issues, and will facilitate timely distribution of information regarding permitting and regulations.

Coordination and Consistency. The NPO will work with public and private entities (individual landowners and non-governmental organizations) to maximize coordination and consistency of policies and programs with the *1989 Plan* and *Handbook*, to the extent allowable by law and agency mandates.

Examples of policies and programs needing increased coordination and consistency include:

- integration of non-governmental, federal, state or landowner acquisitions made to implement the 1989 Plan (e.g. federal refuges, State ecological reserves, conservation easements, State wildlife areas, mitigation bank sites);
- mitigation banking;
- agreements to establish consistent mitigation guidelines, to the extent allowable by law and agency mandates;
- consolidation of permit application forms;
- development of programmatic or master permits for a region or repeated activity;
- development of long-term permits, and/or authorizations;
- coordination with County general plans;

Some of the tools available to the NPO to maximize coordination and consistency include:

- direct input from state and federal agencies represented on the NPO

governing board as nonvoting members and agency staff acting as technical advisors to the NPO;

- contracts and agreements (such as conservation easements or set-aside arrangements) on individual properties which contain enforcement provisions if the contract is violated by either party; and
- When appropriate, development of regional habitat conservation plans pursuant to applicable laws.

Voluntary Land Transactions. The NPO will have the authority to buy and sell land and conduct or engage in other land transactions or agreements with willing participants consistent with the goals of the *1989 Plan and Handbook*. These activities may include full fee acquisition, conservation easements, set-aside agreements, land trades, private donations, land management contracts, mitigation banks, and transfer of development credits. The NPO will work closely with local landowners to facilitate mutually agreeable land protection arrangements, and will be able to act quickly to protect lands and compensate landowners, as appropriate.

Signatory agencies and the NPO will cooperate to identify and obtain funding to support a voluntary land transaction program. Funding could be provided to the NPO to carry out the transactions or the agencies could contract with the NPO to carry out the program.

Riparian Habitat Restoration. The NPO will facilitate and carry out riparian habitat restoration as part of the site-specific planning process. Evaluation of restoration projects within the inner river zone must follow the six guiding principles of the program. The site should then be assessed using the basic principles, management guidelines and restoration priorities described in the Handbook Chapter 1:

1. Protect physical process where still intact.
2. Allow riparian forests to reach maturity.
3. Restore physical and successional process.
4. Conduct reforestation activities.

By focusing on river process, the priorities are designed so that projects are carried out in a manner consistent with the guiding principle on ecosystem management. They are listed in order of their significance to ecosystem management of the Sacramento River and its floodplain.

Flood Management. While it will not have any legal flood control authorities, the NPO will be in a unique position to provide effective support for actions that:

- maintain proper functioning of flood protection works, and
- are consistent with the goals and principles outlined in the *1989 Plan* and *Handbook*.

The NPO will be able to assist landowners in obtaining site specific approvals, assisting project sponsors and regulatory agencies in identifying individuals or entities interested in establishing mitigation banks, assisting in the establishment of such banks, and identifying efficient practices that will minimize the cost and/or acreage of mitigation needed. As a non-regulatory, but interested party, the NPO will be able to monitor progress toward riparian habitat restoration goals, and present an assessment of that progress to local decision makers.

The roles of the NPO in regard to flood protection purposes are to:

- help ensure that flood protection projects accomplish their primary purposes of alleviating flood and erosion damage and protecting lives and property while considering the overall habitat restoration objectives of the *1989 Plan*;
- maintain communication among all interested parties when it is necessary to maintain and repair levees and flood distribution facilities;
- reduce confusion and delay in obtaining project approvals;
- promote floodplain management and habitat conservation practices that maintain the economic and environmental values of the Sacramento River corridor;
- encourage landowner participation in non-structural flood control methods that are economical;
- facilitate a coordinated funding program for projects, and actively encourage creation of, or access to, new funding sources that will accelerate the implementation of the *1989 Plan*; and
- support and assist local maintenance authorities on projects consistent with the goals of the *1989 Plan* and *Handbook*.

Land Management. The NPO and signatory agencies will coordinate land management practices on public and participating private lands to provide for consistency of their practices with the 1989 Plan and Handbook, to the extent allowable by law and agency mandate. The NPO and signatory agencies will cooperate in identifying and obtaining funding sources for land management

activities. Examples of land management activities include: development of site-specific land management plans within the inner zone; bank stabilization that is consistent with the 1989 Plan and Handbook; re-vegetation of levees and other areas where natural re-vegetation will not occur; and control of trespass and vandalism.

The NPO will have the authority to manage lands under three different arrangements:

- 1) to manage whatever land it acquires;
- 2) to oversee land management by private landowners if those landowners are under management agreements with the NPO; and
- 3) to manage lands under contract for other entities such as Department of Fish and Game or The Nature Conservancy. The NPO will work with the various entities to help to co-ordinate the acquisition and management of current and future landholdings in the Conservation Area in order to achieve the objectives of the *1989 Plan* and *Handbook*.

If an agency is unable to begin or finish a project that is consistent with their land management plan, the NPO can offer to complete such a project with the agency's permission. Once the agency has approved an action by the NPO, the NPO will be allowed to complete that action. Such actions may include the enforcement of conservation easement provisions on mitigation sites.

Limiting River Meander (including bank stabilization). The NPO will assist in securing the appropriate agency to address limiting river meander within the boundary of the inner river zone as described in the Handbook. Responsibility for maintaining the boundary of the inner zone would be negotiated on a case-by-case basis as part of individual agreements/contracts.

In some cases, maintaining the inner zone boundary will require bank stabilization. Responsibility for bank stabilization will also be negotiated on a case by case basis as part of agreements/contracts. The NPO may take responsibility for bank stabilization as part of an individual land management agreement, and will be responsible for identifying funding for the work and for ensuring the work is completed as agreed. The Army Corps of Engineers, the Reclamation Board or the Department of Water Resources will act as lead agency for bank stabilization only when it is within the agency's legal authority (such as the Sacramento River Bank Protection Project) and the goals of the 1989 Plan and Handbook.

Funding for bank stabilization could come from a variety of sources such as a funding pool for maintaining the river within the inner zone, river

restoration/habitat fund or flood control funds (see *Handbook* Chapter 9). Under a funding pool, funding for future needs could be created by the establishment of a retainer (a percentage of each project cost) to be placed into a pool for bank stabilization or other activities. This pooled account would provide the property owner with an assurance that river meander beyond an established point would be promptly addressed. The NPO would establish and administer this account and determine its use with the assistance of a technical team.

When bank stabilization is conducted on public and private lands within the Conservation Area, the NPO will actively promote the most effective and least environmentally damaging techniques as per the site specific agreements and/or contracts, and all applicable laws and regulations. The NPO will encourage and promote further research and evaluation of alternative bank stabilization techniques, and promote re-vegetation of levees and rock areas, where appropriate.

The NPO will also work with the regulatory agencies to adopt, when appropriate, a comprehensive habitat plan for threatened and endangered species which could reduce the impact of Conservation Area projects that are consistent with the 1989 Plan and Handbook.

Mitigation. It is anticipated that implementation of the *1989 Plan and Handbook* will provide a net increase in benefits to the environment and to species that currently exist, or may become established in the Conservation Area. Localized or short term impacts may occur, but it is a goal of the NPO that the net environmental benefits will outweigh these adverse habitat impacts and that mitigation of these impacts would be minimized or not required. The NPO will work with regulatory agencies to avoid, minimize or compensate for habitat impacts associated with proposed projects should impacts occur. If mitigation is required, it will be the responsibility of the NPO to work with the regulatory agencies to satisfy the requirements and include the costs as part of the total project cost.

When the NPO is the project proponent, the NPO will be responsible for mitigation, if required, as part of the project unless specific arrangements are made for the landowner to provide mitigation. The NPO will coordinate obtaining permits and/or authorizations as part of the landowner agreement/contracts. If certain project elements, such as bank stabilization, are planned for implementation in the future, the NPO will obtain permits and/or authorizations up front, to the extent possible, to ensure that bank stabilization or other activities can occur as intended, and the landowner and NPO can have certainty that the project can be implemented as was agreed.

Public Information and Technical Assistance. The NPO will provide public information and technical assistance to private and public landowners within the

Appendix J: Memorandum of Agreement

Conservation Area and to the general public on issues such as erosion and deposition, flood control projects, habitat protection and restoration, public access, and recreation. The NPO will serve as a local information clearing house but will refer technical questions such as emergency flood information and legal or regulatory requirements to the appropriate agency. The NPO will also provide information to the public and local communities regarding the benefits of the Conservation Area and of balancing habitat restoration/protection with agricultural land use/protection. Increasing local and regional appreciation of the river system will support the goals of the program and may lead to financial support.

Public Safety and Law Enforcement on Public and Private Lands. The NPO will work with the local, state and federal agencies which have public safety and law enforcement authority to coordinate and maximize enforcement activities within the Conservation Area on both private and public lands. The NPO will work with the enforcement agencies to identify and implement methods to maximize existing enforcement resources. The enforcement activities needing additional attention include vandalism and trespassing on public and private lands.

Monitoring and Research. The NPO will monitor and prepare annual reports on the implementation of the riparian management objectives of the *Handbook* and the success of the protection and restoration efforts within the Conservation Area. Monitoring will help guide future restoration/protection actions within the Conservation Area and help support future funding requests for the program.

The NPO will assist the agencies in furthering research priorities as outlined in the *Handbook* (see pages 9-10 and 9-11).

Funding Sources and Financial Authority. To implement the 1989 Plan and Handbook, the NPO will need funding for all the responsibilities listed above, as well as funding for annual administrative support. Local, state, and federal agencies will assist the NPO in identifying existing or new agency authorities and funding sources which can support implementation of the 1989 Plan and Handbook. The NPO will seek funding from federal, state, local sources, and private donations; revenue from leased lands; and land transactions, to support annual administrative costs. The NPO will support agency funding in order to ensure effective technical support from the respective agency representatives. The Advisory Council is opposed to the NPO having local property tax authority; however, local funding could be sought through other means.

In order to attract the participation of private landowners, the NPO, in coordination with involved signatory parties, must take a leadership role in

seeking and supporting the availability of incentives which include some aspect of river engineering such as bank protection placed to ensure that the meander is limited. Because project components associated with engineering and construction are often more expensive than acquisition or active revegetation, it is anticipated that a significant portion of Riparian Conservation funding will be devoted to such project elements.

It is a goal of the NPO to ensure that adequate funding is obtained for necessary bank protection and other engineered construction. The NPO will work closely with signatory parties to distribute funds appropriately among all aspects of river management. Specifically, all parties will work toward a balanced effort to fund bank protection in order to establish a limited meander while maintaining an ecosystem. The NPO will encourage funding for all activities so the balance can be maintained over time. Furthermore, when site-specific project plans include multiple components such as acquisition, active planting, bank stabilization or flood protection, the NPO will review the project plans to ensure that all aspects are accurately represented in the project budget.

For a guideline on funding elements for various aspects of a restoration project, refer to the *1989 Plan and the Riparian Habitat Committee Report on 1999 Costs of Easements, Acquisitions, Restoration and Bank Protection along the Sacramento River* (Appendix J in Handbook).

The annual report of the NPO will include, at a minimum, a summary of activities and expenditures the NPO has supported in the following categories:

1. Landowner incentives, including set asides, easements, levee, bank stabilization, flood control projects construction and maintenance
2. Fee title land acquisition
3. Habitat restoration
4. Administration
5. Trespass
6. Education
7. Reimbursement of taxes to local government

III. Structure

The *1989 Plan* recommended creation of a governing board... “(with a) balanced representation of participating landowners and public interest groups”. The Advisory Council supports management entity options that are best able to reflect this board representation. An NPO would provide broad flexibility to create a non-governmental board with both landowner and public interest representation. The Advisory Council recommends the establishment of an NPO with a board of directors that will have up to 15 voting members, and six ex-officio (nonvoting) members.

Appendix J: Memorandum of Agreement

Appointing the First Board of Directors. To ensure a large enough initial board, a minimum of four participating counties is required.

The County Board of Supervisors of the participating counties in the Conservation Area (Shasta, Tehama, Glenn, Butte, Colusa, Sutter, and Yolo) will appoint up to 14 of the voting members. Each county will appoint one landowner representative and one public interest representative. One voting member will be chosen by the Secretary of the Resources Agency. This "at large" board member shall not serve as a government representative. As additional counties decide to participate (after the initial four), the Supervisors of that new participating county will appoint representatives to serve on an equal basis with those already appointed.

The Ex-officio nonvoting board members will be:

Director, California Department of Fish and Game
Director, California Department of Water Resources
General Manager, Reclamation Board of California
California-Nevada Operations Manager, U.S. Fish and Wildlife Service
District Engineer, Sacramento District, U.S. Army Corps of Engineers
Area Manager, U.S. Bureau of Reclamation

It is expected that the ex-officio board members from state and federal agencies will help increase the visibility of the nonprofit organization and maintain the linkage to state and federal government which in turn will help increase the likelihood of continued state and federal government support in the future.

Criteria for Nominating/Appointing Board Members. Landowner directors must reside on, own, or manage property in the Conservation Area. He/she must have a demonstrated interest in supporting the goals and objectives of the NPO.

Public Interest directors must reside in the county from which he/she is appointed. He/she must have a demonstrated interest in supporting the goals and objectives of the NPO.

Terms. The first board members will serve 2 and 3-year terms as described below. Thereafter the board members will serve 2-year terms.

2-year term--public interest appointees from Shasta, Glenn and Sutter counties, landowner appointees from Tehama, Butte, Colusa and Yolo.

3-year term--landowner appointees from Shasta, Glenn, and Sutter counties, public interest appointees from Tehama, Butte, Colusa, and Yolo.

Agency Technical Advisors. Federal, state, and local agencies with an interest in the Sacramento River will provide technical staff support, upon request and within their existing resources for planning, implementation, and monitoring of the plan. It is expected that the technical support will be from those agencies signing the MOA. Input from technical advisors could be provided individually and/or by forming a technical committee.

Chairperson. The board elects the chairperson who will serve a 1- year term. The Chairperson will alternate between landowner and public interest board members.

Quorum. Initially, a majority of representatives of the participating counties will represent a quorum. A quorum of a fully appointed board shall consist of eight board members. A vote in favor of a motion by eight board members present at a meeting shall constitute the act of the Board as long as those voting in favor include at least three landowner board members and three public interest board members.

Manager/Executive Director. A Manager/Executive Director will be selected by the Board.

Board Meetings. Board meetings will be held in either a central location or will be rotated among different locations within the Conservation Area.

REFERENCES

- Anderson, City of. 1989. *City of Anderson General Plan-Goals and Policies*. Revised edition.
- Anderson Planning Department. April 1997. Personal communication.
- Bell, Gary. 1993. Biology and Growth Habitats of Giant Reed (*Arundo donax*). In, *Arundo donax Workshop Proceedings*. Team Arundo, California Exotic Pest Plant Council. Ontario, California.
- Butte, County of. 1977. *Butte County General Plan, Conservation Element*.
- _____. 1991. *Butte County General Plan, Land Use Element*.
- CALFED Bay-Delta Program. 1997. *A CALFED Bay-Delta Program Overview: The Restoration Coordination Program*. Informational pamphlet.
- California Department of Fish and Game. 1997. *Wildlife Habitat Relationships Model*.
- _____. 1996. *Draft Land Management Plan for the Sacramento River Wildlife Area*.
- _____. 1996. Natural Diversity Data Base of the Natural Heritage Division.
- _____. 1994. Database of Agricultural Water Diversions Preliminary Draft Information. Prepared by Inland Fisheries Division.
- _____. 1986. *Preliminary Description of the Terrestrial Natural Community of California*. Prepared by Robert Holland for the Nongame Heritage Program.
- _____. 1979. *The California Riparian Study Program. Phase 1: Background Studies and Program Design for Phase 2*. Prepared by Richard E. Warner.
- California Department of Parks and Recreation. 1994. *Upper Sacramento River Public Lands, Access, and Recreation Facilities Inventory: Maps and Database Table*. Prepared by Steve Greco.
- _____. 1988. *California Wetlands: An Element of the California Outdoor Recreation Planning Program*.
- California Department of Water Resources. 1996. Sacramento River Geographic Information System.

References

- _____. 1995. *Memorandum Report - Sacramento River Meander Belt Future Erosion Investigation*. Prepared by Koll Buer and Kevin Weherly, Northern District.
- _____. 1995. *Sacramento River Bank Survey*, Colusa- Verona Reach. Unpublished.
- _____. 1994. *Butte County Land Use Survey*. Unpublished mapping.
- _____. 1994. *Sacramento River Bank Survey*, Chico Landing to-Red Bluff Reach. Unpublished.
- _____. 1994. *Sacramento River Bank Erosion Investigation Memorandum Progress Report*. Prepared by Koll Buer, Northern District.
- _____. 1994. *Shasta County Land Use Survey*. Unpublished mapping.
- _____. 1994. *Tehama County Land Use Survey*. Unpublished mapping.
- _____. 1993. *Colusa County Land Use Survey*. Unpublished mapping.
- _____. 1993. *Glenn County Land Use Survey*. Unpublished mapping.
- _____. 1990. *Sutter County Land Use Survey*. Unpublished mapping.
- _____. 1989. *Yolo County Land Use Survey*. Unpublished mapping.
- _____. 1987. *Land Use Changes in the Sacramento River Riparian Zone, Redding to Colusa, Third Update - 1982 to 1987*. Prepared by R. McGill, Northern District.
- _____. 1984. *Butte and Sutter Basins Water Data Atlas*.
- _____. 1984. *Middle Sacramento River Spawning Gravel Study*.
- _____. 1983. *Land Use Changes in the Sacramento River Riparian Zone, Redding to Colusa, A Second Update - 1977 to 1982*. Prepared by R. McGill, Northern District.
- _____. 1981. *Upper Sacramento River Baseline Study: Hydrology, Geology, and Gravel Resources*. Prepared by Northern District.
- _____. 1980. *Upper Sacramento River Spawning Gravel Study*.
- _____. 1978. *General Comparison of Water District Acts*. DWR Bulletin No. 155- 77.
- _____. 1975. *Land Use Changes in the Sacramento River Riparian Zone, Redding to Colusa*. Prepared by R. McGill, Northern District.
- California Office of Permit Assistance. 1977. *California Permit Handbook*. Prepared by California Trade Consultant and WESCO Environmental Consultants.

References

- California Resources Agency. 1989. *Upper Sacramento River Fisheries and Riparian Habitat Management Plan*. Prepared by SB 1086 Advisory Council.
- California State Governor's Office of Planning and Research and California Department of Water Resources. 1979. *The California Water Atlas*. Sacramento, California.
- California State Lands Commission. 1993. *California's Rivers: A Public Trust Report*. Principle Contributor D. Jacobs, Ph.D.
- California State Reclamation Board. 1991. *The Reclamation Board*.
- California State University, Chico, Geographical Information Center. 1995 Butte and Glenn County Riparian Vegetation Study.
- _____. 1994. Tehama County Riparian Vegetation Study.
- _____. 1993. Shasta County Riparian Vegetation Study.
- Colusa, City of. 1994. *City of Colusa General Plan*.
- _____. 1988. *City of Colusa Community Development Program: Downtown Development/Preservation Program*. Prepared by Zephyr Urban Management Associates.
- Colusa, County of. 1989. *Colusa County General Plan*. Prepared by Sedway-Cooke Associates.
- Conrad, Susan, Rod L. MacDonald and Robert F. Holland. 1977. Riparian Vegetation and Flora of the Sacramento Valley. In: *Riparian Forests in California*. Institute of Ecology Publications No. 15.
- Gaines, David. 1977. The Valley Riparian Forests of California: Their Importance to Bird Populations. In: *Riparian Forests in California*. Institute of Ecology Publications No. 15.
- _____. 1995. *Glenn County Codes*.
- Glenn, County of. 1993. *Glenn County General Plan, Volume 1*. Prepared by QUAD Consultants.
- Griffin, James R and William B. Critchfield. 1972. *The Distribution of Forest Trees in California*. USDA Forest Service Research Paper No. PSW-82/1972.
- Hamblin, Mark. Yolo County Planning Department. April 1997. Personal communication.
- HDR Engineering. 1993. *Glenn-Colusa Fish Screen Improvements, Draft Geomorphological Investigations*. Prepared by Mathias G. Kondolf.

References

- Helley, Edward J. And David S. Harwood. 1985. *Geologic Map of the Late Cenozoic Deposits of the Sacramento Valley and Northern Sierran Foothills, California*. U.S. Geologic Survey.
- Jackson, Nelroy E. 1993. Control of *Arundo donax*: Techniques and Pilot Project. In: *Arundo donax Workshop Proceedings*. Team Arundo, California Exotic Pest Plant Council. Ontario, California.
- Katibah, Edwin F. 1984. A Brief History of Riparian Forests in the Central Valley of California. In, *California Riparian Systems: Ecology, Conservation, and Productive Management*. R.E. Warner and K.M. Hendrix, eds. Berkeley: University of California Press.
- Kelly, Robert. 1989. *Battling the Inland Sea: American Political Culture, Public Policy, and the Sacramento Valley 1850-1896*. Berkeley: University of California Press.
- McAlexander, L. Breck. 1993. *Species-area relations of breeding birds on the Middle Sacramento River, California*. Unpublished manuscript.
- National Oceanic and Atmospheric Administration. 1995. *Watershed Restoration: A Guide for Citizen Involvement in California*. NOAA Coastal Ocean Program Decision Analysis Series No. 8. Prepared by William M. Kier and Associates. Silver Spring, Maryland.
- Nelson, C.W. and J.R. Nelson. 1984. *Central Valley Riparian Mapping Project*.
- Priestaf, Iris. 1983. *Sacramento River Seepage: Alternative Mitigating Measures*. Ph.D. Dissertation. University of California, Berkeley.
- Red Bluff, City of. 1993. *Red Bluff General Plan*.
- Redding, City of. 1995. *Redding General Plan*. Prepared by Department of Planning & Community Development.
- Roberts, Warren G., Greg J. Howe and Jack Major. 1977. A Survey of Riparian Forest Flora and Fauna in California. In *Riparian Forests in California: Their Ecology and Conservation*. Ann Sands, ed. Davis, California: Institute of Ecology.
- Shasta, County of. 1993. *Shasta County General Plan*. Revised edition.
- Sutter, County of. 1994. *Sutter County General Plan*.
- Sutter County Resource Conservation District. 1996. *1996 Annual Report and 1997 Work Plan*.
- Tehama, City of. 1972. *City of Tehama General Plan*.
- Tehama, County of. 1993. *Tehama County General Plan*.
Tehama County Flood Control and Water Conservation District. *Agency Profile*.

- _____. 1996. *Coordinated AB 3030 Groundwater Management Plan*. Prepared by Dan Keppen and Scott Slater.
- The Habitat Restoration Group. 1997. *Environmental Laws, Regulations, and Policies Pertaining to the Protection and Enhancement of Natural Resources in the Deer Creek Watershed*.
- The Habitat Restoration Group. 1997. *Federal and State Agencies Concerned With the Protection and Management of California's Wetlands, River Systems, and Watersheds*.
- The Nature Conservancy. 1996. *Reconnaissance Investigation of Streambank Erosion and Conceptual Recommendations for Treatment at the Flynn Unit of the Sacramento National Wildlife Refuge*. Prepared by Graham Matthews.
- Thompson, Kenneth. 1961. Riparian Forests of the Sacramento Valley, California. In *Annals of the Association of American Geographers* 51: 294-315.
- TRW-REDI. 1996. Property data disks for Shasta, Tehama, Butte, Glenn Sutter, Colusa and Yolo Counties.
- United States Army Corps of Engineers, Sacramento District. 1997. *Preliminary Final Report, Sacramento River Bank Protection Project (SRBPP) Sacramento River and Tributaries Breach at Road 29 Near RM 188, Glenn County, California*. Prepared by Ayres Associates.
- _____. 1996. *Murphy Slough, California Habitat Restoration: Project Modification Report and Environmental Assessment*. Draft.
- _____. 1991. *Sacramento River Sloughs, and Tributaries, California, 1991 Aerial Atlas*. Sacramento, California.
- _____. 1990. *Geomorphic Analysis and Bank Protection Alternatives Report for Sacramento River (RM 78-194) and Feather River (RM 0-28)*. Prepared by Water Engineering and Technology, Incorporated. Fort Collins, Colorado.
- _____. 1995. *Wild, Scenic, and Recreational Characteristics: Sacramento River, California, Keswick Dam to Sacramento*.
- _____. 1988. *Butte Basin Reach, Sacramento River Bank Protection Project – Final Supplement III to Final Environmental Impact Statement and Final Environmental Impact Report*.
- _____. 1988. *Geomorphic Analysis of Sacramento River, Phase I Report: Geomorphic Analysis of Butte Basin Reach, River Mile 174 to River Mile 194*. Prepared by Water Engineering and Technology, Inc.
- _____. 1986. *Riparian Planting Design Manual for the Sacramento River: Chico Landing to Collinsville*. Prepared by Aqua Resources Incorporated and Holton Associates.

References

- _____. 1975. *Wild, Scenic and Recreational Characteristics, Sacramento River, California - Keswick Dam to Sacramento*.
- United States Army Corps of Engineers, Water Resources Planning Branch. 1981. *Sacramento River and Tributaries Bank Protection and Erosion Control Investigation, California*.
- United States Department of Agriculture. 1994. *Colusa County Soil Survey*. Preliminary draft.
- _____. 1974. *Soil Survey of Shasta County Area, California*.
- _____. 1968. *Glenn County Soil Survey*.
- United States Fish and Wildlife Service. 1992. *Shaded Riverine Aquatic Cover of the Sacramento River System: Classification as Resource Category 1 Under the FWS Mitigation Policy*. Sacramento, California.
- _____. 1990. *Baseline Habitat Inventory and Mapping for Sacramento River Bank Protection Project California, Third Phase*. Prepared by Rebecca A. Keck.
- United States Fish and Wildlife Service and National Marine Fisheries Service. 1996. *Endangered Species Habitat Conservation Planning Handbook*.
- United States Geological Survey. 1977. *Lateral Migration of the Middle Sacramento River, California*. Water Resources Investigations No. 77-43. Prepared by James Brice. Menlo Park, California.
- Yolo, County of. 1995. *Yolo County Draft Habitat Conservation Plan*. Prepared for the U.S. Fish and Wildlife Service, California Department of Fish and Game, County of Yolo, and the cities of Davis, West Sacramento, Winters and Woodland. Prepared by EIP Associates.
- _____. 1983. *Yolo County General Plan*. Prepared by Yolo County Community Development Agency.